

# **U.S.S. TEXAS (BB-35)**

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## **OPTION 5 TANK INSPECTION AND REPAIR ASSESSMENT**



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Vessel Survey Report No. 2443

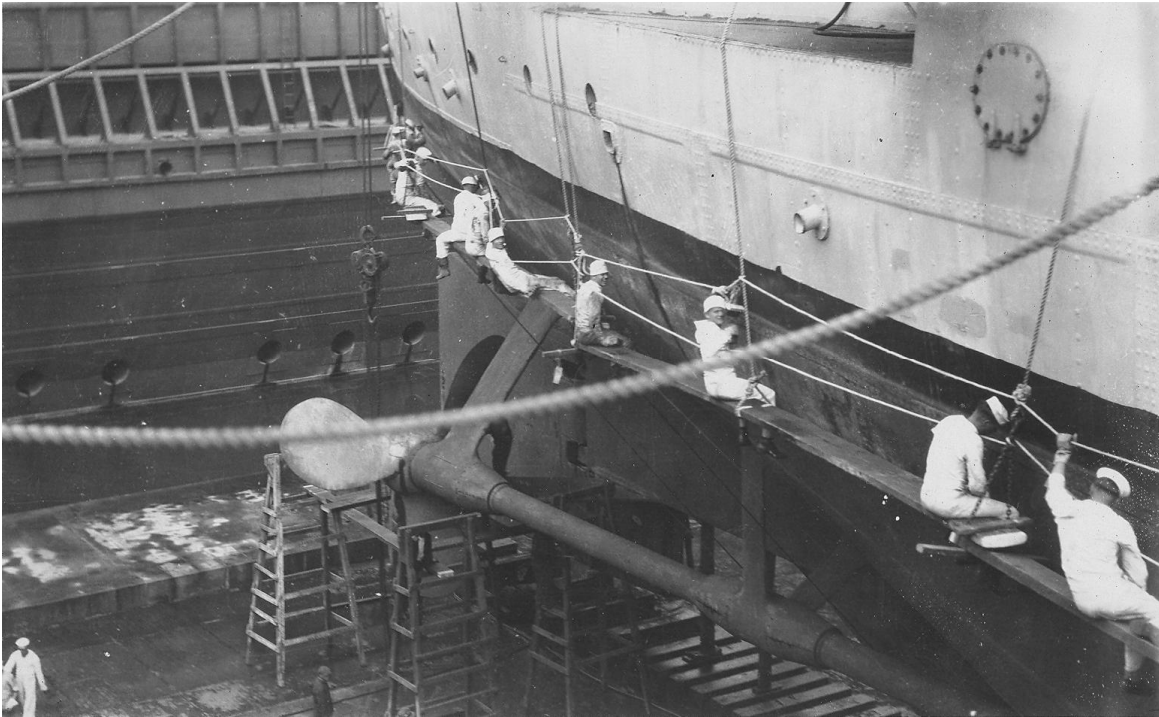
Vessel surveyed at: La Porte, Texas  
Dates of Survey: January 2012  
Date of Final Report: February 2013

Vessel surveyed: U.S.S. TEXAS (BB-35)

Survey commissioned by: Texas Parks & Wildlife  
Battleship TEXAS State Historic Site  
3523 Independence Parkway South  
La Porte, Texas 77571

Purpose of survey: Tank Inspection & Repair Assessment

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Crew on scaffolding painting shell plating at waterline  
of USS TEXAS in drydock. (NARA & TPWD Collections)

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## EXECUTIVE SUMMARY

This report presents an assessment of the present condition of the centerline tankage as obtained from a thorough and detailed inspection carried out in January 2012. Critical problem areas have been identified as those that merit immediate consideration and repair before the re-floating/super-flooding of the vessel through dredging and the preparation for the Option 5 berthing configuration.

The terms “Option 5” and “Option 6” refer to berthing configurations considered subsequent to Options 1 through 4 considered in the Dry Berth of the Battleship Texas State Historic Site Phase I: Conceptual Design Report (AECOM, September 2011). Option 5 is a berthing configuration that grounds the ship in the dry, directly on the sand within her current berth. Option 6 is an option that includes only selected ship repairs, and the leaves the ship in place in her wet berth with no changes to the berth itself.

It is quite apparent that repairs will be required for the vessel’s frames, floors, bulkheads, stanchions and shell plating after Frame # 60. These concerns/conclusions were raised in the Phase I Hull Survey; this report will characterize the scope and estimated costs for those repairs.

This report covers only the centerline tanks and spaces at the stem of the vessel and from Frame # 60 to the stern; other outboard tankage within the original shell of the ship has not been inspected, nor have the extensive blister tank system outboard of the original shell of the ship been inspected. Whether Option 5 or Option 6 berthing alternatives is ultimately chosen, the end game is the same as the vessel will be required to float on her own bottom throughout. No estimate of scope and cost for repairs can be estimated outside of the inspected areas.

The reporting for this report will commence at the stem for the forepeak area, proceeding aft to the B-2 to B-4 boiler rooms and inner bottom/hold tankage, thence to the pair of enginerooms and associated inner bottom tankage, proceeding aft to tankage to vicinity of Frame # 115 (After Emergency Diesel Room). The remaining structure aft of Frame # 122 to the stern will be reported starting from the keel up to the bottom of the 2<sup>nd</sup> Deck.

A description of repair methodology within each compartment, required remediation within each space, materials required, and estimated costs for repairs are included within the body of this report. Mr. Jerry Possehl, N.A. has added comments on the repairs as required within each section of the report.

A separate estimate of total project costs is provided within the Appendix.

The estimated total cost for repairs within this cover is \$21,155,869.23

Unless these issues are addressed satisfactorily before the vessel is re-floated, there is significant risk in causing serious and irreparable damage to the vessel.

U.S.S. TEXAS (BB-35)  
DETERIORATED STRUCTURE FRAME # 64 TO STERN

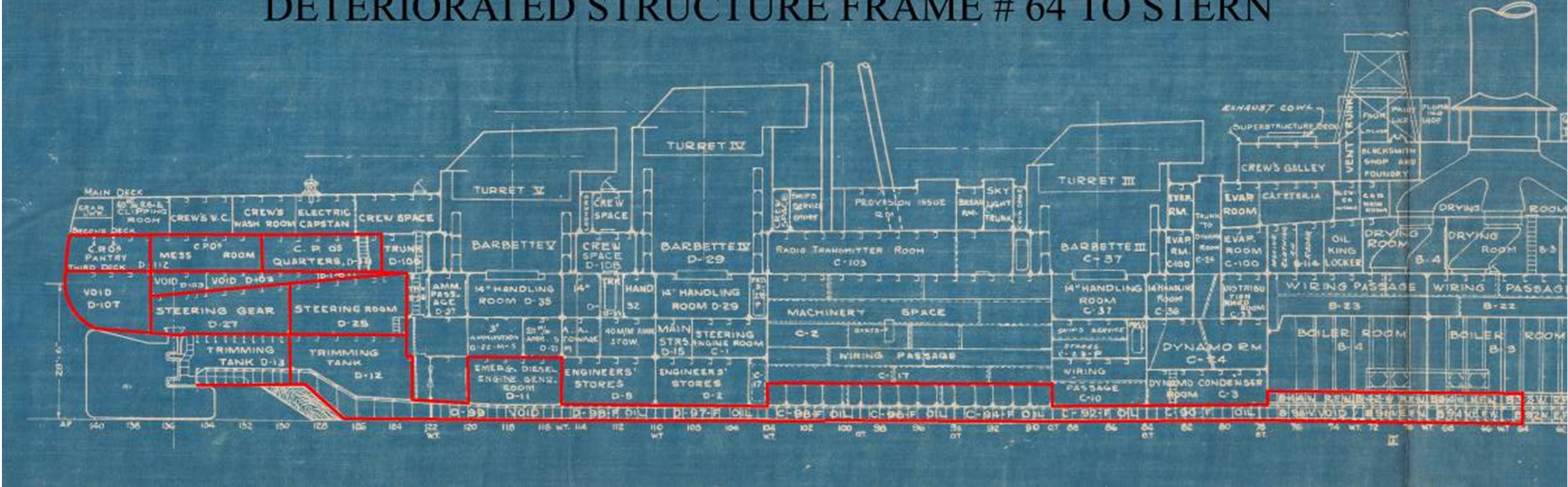


Figure 1: Structurally Deficient and Critical Areas of Vessel (Demarcated Within Red Lines)



## 1. INTRODUCTION

This tank inspection survey of the centerline tankage of the battleship U.S.S. TEXAS was conducted (January 2012) where she lay (aground within the slip bottom; afloat only on high water events) at the San Jacinto State Battleground Park within her side slip/berth in the Houston Ship Channel.

The purpose of this tank inspection was to ascertain the scope and estimated costs for repairs needed for the vessel under Option 5 scenarios.

The surveyor was tasked with identifying issues of structure, internal tankage and the present/future issues facing the ship from a material condition perspective. The surveyor was also tasked with recommending general alterations or improvements needed within this tankage to properly support overhead components (boilers, main engines, structure, etc.) on this vessel to allow a safe floating and aground condition when the ship finally comes to rest in her current berth.

Inspections of the outboard blister tank appendages were not a part of this survey, nor were the balance of tankage outside of the centerline tanks.

The ship's staff assisted greatly in this task of opening tank covers and hatches where they could safely enter spaces. Spaces not inspected are not noted within this report. Entry into fuel and/or ballast tanks was subject to air quality requirements under 29 CFR Code of Federal Regulation requirements and this was done with inspections carried out by a Marine Chemist. Where tank inspections were not possible, visual inspections from tank manhole covers was accomplished with photographs being taken by ISHOT 550 HD camera. The underwater appendage was not observed.

The inspection of this vessel started from forward to aft, and top to bottom and shall be described following that same course here in the narrative, except after Frame # 122 where extensive repairs dictate that work commence at the keel and work up through the structure.

The Code of Federal Regulations (CFR), American Boat & Yacht Council (ABYC), International Marine Organization (IMO), National Fire Protection Association (NFPA), and the Society of Naval Architects and Marine Engineers (SNAME) are utilized in compiling this report. Individual reference to subchapters of the above is not made within the body of this report. Other sources include the 'U.S. Navy Towing Manual', 'Manual on Ship Construction', George C. Manning: Van Nostrand Co., and 'Standards For Steel Hulled Vessels', American Bureau of Shipping, 'Stability and Trim for the Ship's Officer' by William E. George, Cornell Maritime Press and 'Ship Design and Construction' by the Society of Naval Architects and Marine Engineers.

## 2. STEM TANKAGE

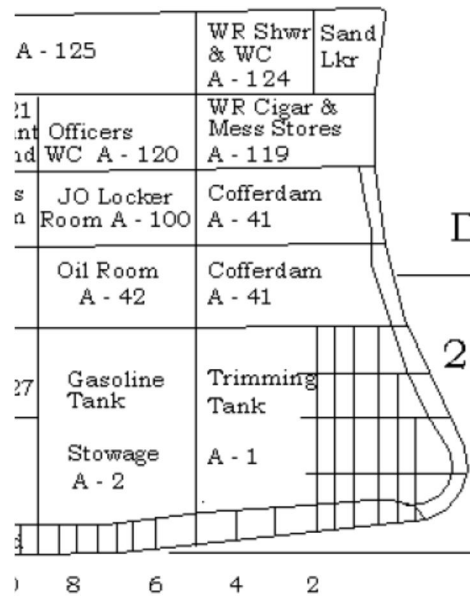


Figure 2: Stem Tankage

### 2.1 COFFERDAM, A-41, Stem to Frame 5

Space is heavily corroded, but not structurally deficient. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications. Stem casting intact and in good repair on both flats.

Stem aprons heavily corroded at 30 - 40% loss of structural integrity. Transverse framing showing 30%+ loss of integrity. Aft bulkhead intact. No evidence of leakage.



Figure 3: Stem Aprons, Looking Down in A-41.

## **2. STEM TANKAGE (cont.)**

### **2.2 Trimming Tank, A-1, Stem to Frame #5**

Space is heavily corroded, but not structurally deficient. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.

Stem aprons heavily corroded at 50%+ loss of structural integrity. Upper transverse framing showing 30%+ loss of integrity; lower transverse framing showing 40%+ loss of integrity. Aft bulkhead intact with 30-40% wastage. Keel showing 30 – 40% wastage in areas, but intact. Standing water 2-3” with heavy muck/rust/scale present. Condensation standing on horizontal aprons and shelves causing heavy corrosion.



**Figure 4: Keel and Bilges at Forward End of A-41**



**Figure 5: Keel and Floors in A-41**



## 2. STEM TANKAGE (cont.)



Figure 6: Standing Water on Side Shell Aprons Due to Condensation in A-41



Figure 7: Heavy Rust/scale, and Condensation on Side Shell Apron in A-41



## 2. STEM TANKAGE (cont.)

### 2.3 GASOLINE TANK, A-2, Frames #5 to #9

Space is heavily corroded, but not structurally deficient. Peeling paint and rust/scale abound. This space requires no structural repairs or modifications.

Side shell aprons heavily corroded at 50%+ loss of structural integrity. Upper transverse framing showing 30%+ loss of integrity; lower transverse framing showing 40%+ loss of integrity. Aft bulkhead intact with 30-40% wastage. Keel showing 30–40% wastage in areas, but intact. Standing water 2-3" with heavy muck/rust/scale present. Condensation standing on horizontal aprons and shelves causing heavy corrosion.



Figure 8: Top of Gasoline Storage Tanks within A-2

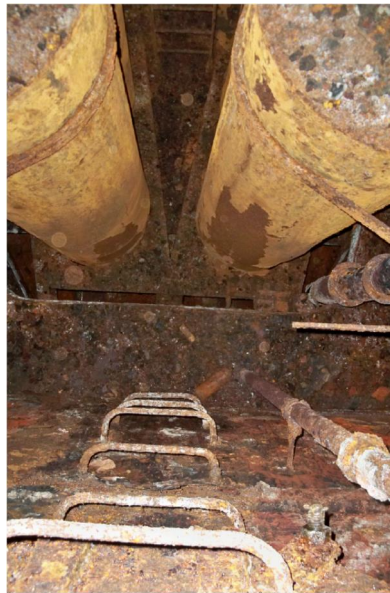


Figure 9: Looking Down to Floor at Aft Bulkhead in A-2

### 3. BOILER ROOM #2

#### B-2 FIREROOM, FRAMES 52 - 60, FRONTAL VIEW OF BOILERS, LOOKING AFT

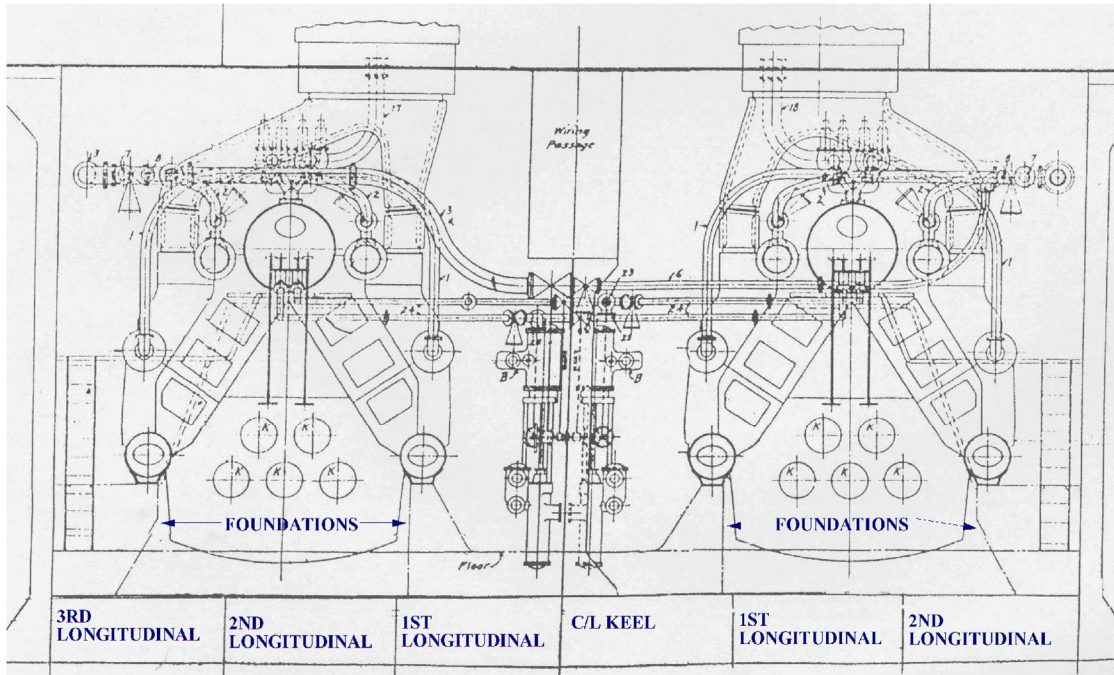


Figure 10: Frontal View of Boilers in B-2 Fireroom, Looking Aft

Material condition of both boilers show them to be in good repair. Bases of both boiler units are intact with structural foundations in good repair with no repairs required. The main floor over the Hold Tankage is intact with no repairs required. Bulkheads and vertical supports intact and in good condition.



Figure 11: Base Foundation and Intact Floor of Port Side Boiler in B-2 Fireroom



### 3. BOILER ROOM #2 (cont.)



Figure 12: Base Foundation and Intact Floor of Starboard Side Boiler in B-2 Fireroom

#### 3.1 TANK B-2-2-W (port, Frames 52 - 56)

Not previously inspected under the Option 1 Survey, this tank space with three transverse frames and two longitudinal frames is directly under boiler room fuel manifolds and miscellaneous equipment; tank components are in good structural condition with no repairs required at this time. Both transverse and longitudinal support frames are intact with minimal plate loss of 20 – 40% with minimal deflection of steel plate. The floor of this tankage is heavily rusted/scaled, but with no standing water present. Forward bulkhead intact showing 20 - 30% plate loss and the aft bulkhead intact with 30-40% plate loss with rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 20-40% in spots, but is not in need of repair at this time. Evidence of previous long term standing water.



Figure 13: B-2-2-W. Views of Tank Showing Relatively Good Structural Condition of Scantlings

### 3. BOILER ROOM #2 (cont.)

#### 3.2 TANK B-2-1-W (stbd., Frames 52 - 56)

Not previously inspected under the Option 1 Survey, this tank space with three transverse frames and two longitudinal frames is directly under both boiler room fuel manifolds and miscellaneous components; tank components are in good structural condition with no repairs required at this time. Both transverse and longitudinal support frames are intact with plate loss in areas averaging 20 – 40% with minimal deflection of steel plate. The transverse and longitudinal frames in this compartment have areas of ‘swiss cheese’ (holed plating); it is not considered a threat for the immediate period (10 -15 years) given the structural condition of adjacent scantlings, the strength of the floor above and the foundations for the boilers. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage, but with no standing water present. Forward bulkhead intact showing 30 - 40% plate loss and the aft bulkhead intact with 30-40% plate loss with rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 50% in areas of deep pitting, but is not in need of repair at this time.



Figure 14: B-2-1-W. Holed Transverse Frame within Tank



Figure 15: B-2-1-W. Typical Transverse Frame within Tank, Showing Hatch to Inner Bottom

### 3. BOILER ROOM #2 (cont.)

#### 3.3 B-2-4-W, (PORT, Frames 56 – 60 ½)

Not previously inspected under the Option 1 Survey, this tank space with four transverse frames and two longitudinal frames is directly under the port boiler; tank components are in good structural condition with no repairs required at this time. Both transverse and longitudinal support frames are intact with plate loss in areas averaging 30 – 50% with minimal deflection of steel plate. Wastage of the boiler foundation is 40 – 60%. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage, but with no standing water present. Forward bulkhead intact showing 30 - 40% plate loss and the aft bulkhead intact with 30 - 40% plate loss with rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 50% with keelson knees showing 50 – 70% loss in areas of deep pitting, but is not in need of repair at this time.



Figure 16: B-2-4-W. Boiler Foundation Knee with Longitudinal Frame



Figure 17: B-2-4-W. Typical Longitudinal Frame within Tank



### 3. BOILER ROOM #2 (cont.)

#### 3.4 B-2-3-W, (STBD, Frames 56 – 60 ½)

Not previously inspected under the Option 1 Survey, this tank space with four transverse frames and two longitudinal frames is directly under the starboard boiler; tank components are in fair - good structural condition with no repairs required at this time. Both transverse and longitudinal support frames are intact with plate loss in areas averaging 30 – 60% with minimal deflection of steel plate; steel plate delaminating on both sides equally. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage, but with no standing water present. Forward bulkhead intact showing 30 - 40% plate loss and the aft bulkhead intact with 30 - 40% plate loss with rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 50% in areas of deep pitting with knees showing 50%+ loss in aft area of tank, but is not in need of repair at this time.



Figure 18: B-2-3-W. Typical Longitudinal Frame within Tank, Showing Boiler Foundation



Figure 19: B-2-3-W. Delaminated Steel Scantling, Typical for Most Frames within this Tank

#### 4. BOILER ROOMS #3 & #4, Frames 60 1/2 - 77 1/2

Material condition of boilers in both firerooms show them to be in fair repair with base plates and Hold Tankage framing rotting away. Bases of both boiler units are somewhat intact with structural foundations in good repair with no repairs required. The main floors over the Hold Tankage in both Firerooms is holed throughout with repairs required. Bulkheads and vertical supports for both firerooms are intact and in fair condition forward and aft.

The condition of both boiler room floors and the condition of support frames within the Hold Tankage beneath the boilers mandates that support of the pair of boilers each in B-3 and B-4 Firerooms; this becomes necessary while the floors and Hold Tankage are rebuilt. The support for the boilers can be achieved by suspending them from the armor deck above. A possible approach would be to utilize steel cable fastened to three 24" wide x 30' long double, 2 ply nylon straps per boiler (for supporting the underneath of the boilers) thence to the overhead deck where sistered 10 x 60 I-beams could rest on the deck with 1.25 x 7 threaded rod attached to the cable ends. The cable ends would be attached to 1.25" bright wire, uncoated, fiber core (FC) wire rope improved plow steel (IPC) with a breaking load of 129,200 lbs down to the nylon straps. The threaded rod could be tensioned to just take the load of the boiler off of the sub-structure allowing repairs to be made in safety. It is estimated that using hardware of this size would result in a safety factor of four (4) and could be tested with dial indicators for working loads; anticipate three straps per boiler. Section 106 remediation to put this back to original would require removal of the support gear and welding the circular holes in the armor deck back to original.

For the purposes of cost estimating, the size of the hardware used to suspend the boilers is approximated. The final method of removing the load of the boilers from the structure beneath will require design by a licensed engineer.

The drawing below pertains to the end on view of the I-beam resting on the armored deck over the four boilers in B-3 & B-4 Firerooms.

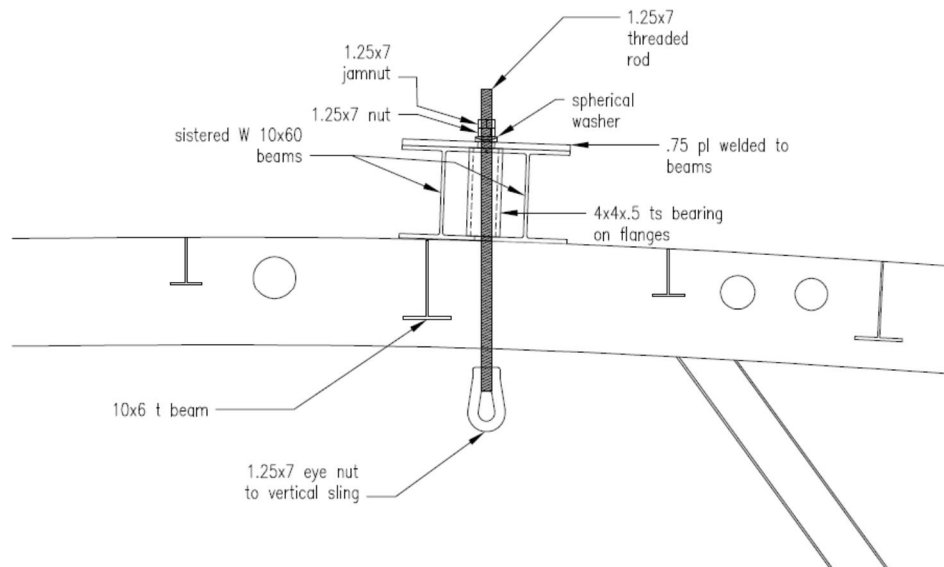
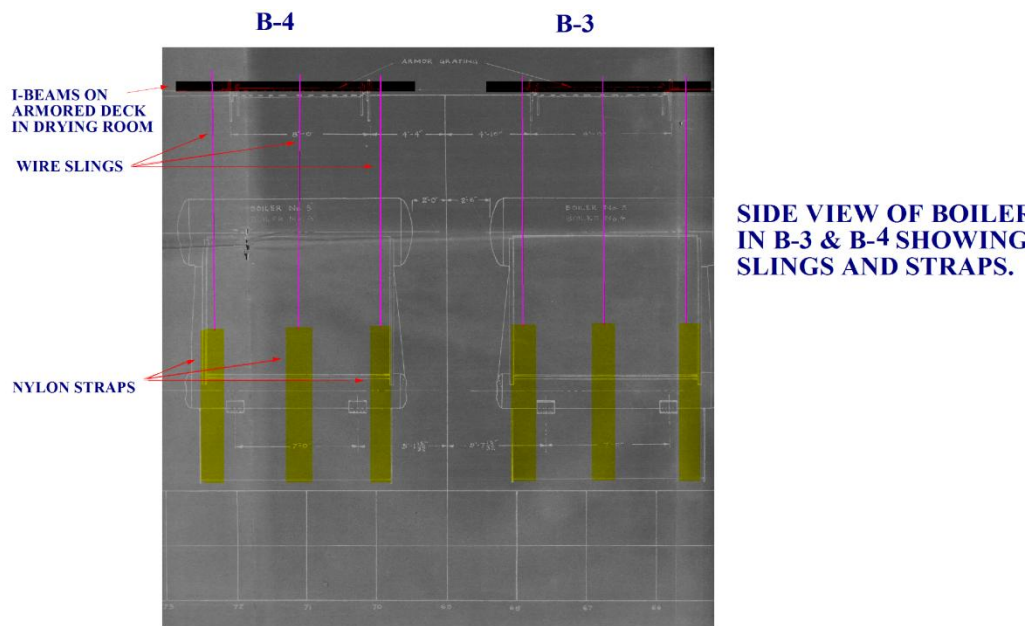


Figure 20: Detail of I-beam and Threaded Rod for Boiler Supports  
(Hardware sizes estimated)

#### 4. BOILER ROOMS #3 & #4, Frames 60 1/2 - 77 1/2 (cont.)



**Figure 21: View of Sides of Boilers showing I-beams, Wire and Nylon Straps for B-3 & B-4 Firerooms**

The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boilers will allow steel plate to be inserted into the Hold tankage space to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

Remediation of 4" on either side of a cut/burn areas will be required as per 29 CFR for lead paint issues. Asbestos remediation will be required for friable lagging left on the floors of the boiler rooms and for dust in bilge spaces. Piping may require oil remediation as needed.

Once the tankage below has been repaired, the deck can be repair/replaced as needed. Each Boiler Room has approximately 1,632 square feet of floor space. B-3 Boiler Room will require 800 square feet of new ½" A-36 mild steel deck plating, primarily under both boilers and in other scattered areas of the space. B-4 Boiler Room will require 800 square feet of new ½" A-36 mild steel deck plating, primarily under both boilers and in other scattered areas of the space.

Deck Replacement in B-3 & B-4 Boiler Rooms Tasking:

Remediation of asbestos as needed in Drying and Boiler Rooms. Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR

Crop out and replace 1,600 sq. ft of ½" A-36 steel deck plate as needed.

Replace stanchions and deck grating..

Prime all new work with two coats of INTERNATIONAL 300V epoxy primer.

#### **4. BOILER ROOMS #3 & #4, Frames 60 ½ - 77 1/2 (cont.)**



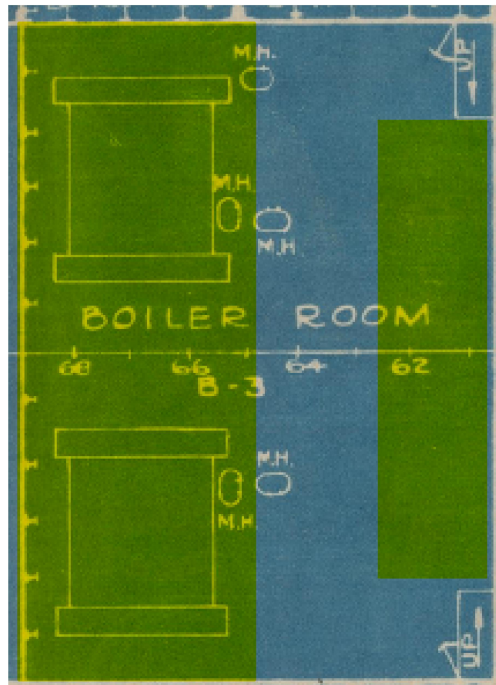


Figure 22: Shaded Area in Yellow within B-3 Signifying Areas where Floors Need Replacement



Figure 23: Wasted Floor Under Rear of Port Side Boiler in B-3

#### 4. BOILER ROOMS #3 & #4, Frames 60 1/2 - 77 1/2 (cont.)

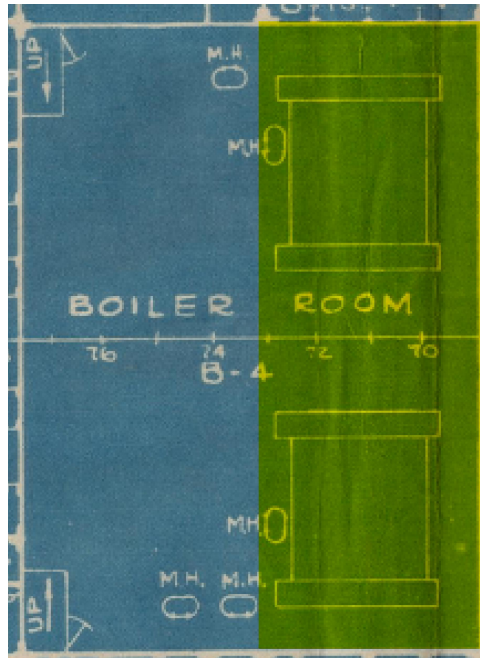


Figure 24: Shaded Area in Yellow within B-4 Signifying Areas where Floors Need Replacement



Figure 25: Wasted Floor Under Rear of Port Side Boiler in B-4

##### 5. B-3, HOLD TANKAGE, Frames 60 ½ - 69

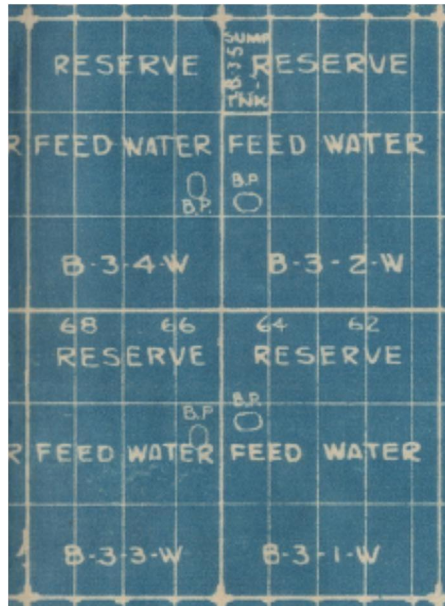


Figure 26: B-3 Hold Tankage

### 5.1 B-3-2-W, Port, Reserve Water Feed Tank

Not previously inspected under the Option 1 Survey, this tank space with four transverse frames and two longitudinal frames is directly under both boiler room fuel manifolds and miscellaneous components; tank components are in fair/good structural condition with no repairs required at this time. Both transverse and longitudinal support frames are intact with plate loss in areas averaging 40 – 50%; transverses deflected 1”+. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage. Forward bulkhead intact showing 30 - 40% plate loss and the aft bulkhead intact with 40- 50% plate loss with heavy rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 50% in areas of deep pitting, but is not in need of repair at this time. Compartment is dry.

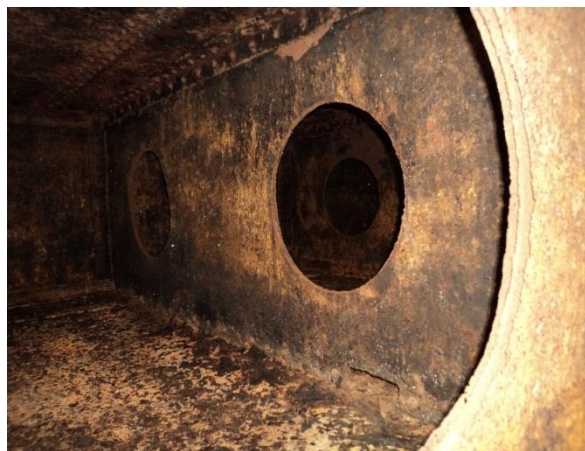


Figure 27: Typical Condition within B-3-2-W Tank

## 5. B-3, HOLD TANKAGE, Frames 60 ½ - 69 (cont.)



### 5.1 B-3-2-W, Port, Reserve Water Feed Tank (cont.)



Figure 28: Typical Condition within B-3-2-W Tank



Figure 29: Typical Condition within B-3-2-W Tank

### 5. B-3, HOLD TANKAGE, Frames 60 1/2 - 69 (cont.)

## 5.2 B-3-1-W, Starboard, Reserve Feed Water Tank

Not previously inspected under the Option 1 Survey, this tank space with four transverse frames and two longitudinal frames is directly under both boiler room fuel manifolds and miscellaneous components; tank components are in fair/good structural condition with no repairs required at this time. Both transverse and longitudinal support frames are intact with plate loss in areas averaging 30 – 40% with minimal deflection of steel plate. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage, but with no standing water present. Forward bulkhead intact showing 30 - 40% plate loss and the aft bulkhead intact with 40- 50% plate loss with heavy rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 40% in areas of deep pitting, but is not in need of repair at this time.



Figure 30: Typical Condition of Transverse Frames within B-3-1-W



Figure 31: Forward Longitudinal Frame within B-3-1-W

## 5. B-3, HOLD TANKAGE, Frames 60 ½ - 69 (cont.)

### 5.3 B-3-4-W, Port, Reserve Feed Water Tank

Not previously inspected under the Option 1 Survey, this tank space with three transverse frames and two longitudinal frames is directly under the port boiler; tank transverse and longitudinal frames require extensive rebuilding and are in poor/fair structural condition with repairs required at this time. Both transverse and longitudinal support frames have plate loss in all areas averaging 50 – 70% with deflection of steel plate. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage, but with no standing water present. Forward bulkhead intact showing 40 - 50% plate loss and the aft bulkhead intact with 40- 50% plate loss with heavy rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 40% in areas of deep pitting, but is not in need of repair at this time.

Tank is sized 16' long x 24' wide.

Tank repair methodology in B-3 requires that both boilers be supported as previously discussed in #4, The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boiler will allow steel plate to be inserted into the Hold tankage space to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

Tasking for B-3-4-W

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR

Crop and replace longitudinal plating (1/2" x 16L' x 4' H) on #1 longitudinal,. 64 sq. ft x 1/2"

Crop and replace longitudinal plating (1/2" x 16'L x 4' H) on #2 longitudinal. 64 sq. ft x 1/2"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 1 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 2 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 3 transverse 96 sq. ft x 3/8"

Replace four 1/2" plating knees for boiler foundations. 40 sq. ft x 3/8"

Replace two 1/2" x 4" x 10" x 24' channel beams for boiler foundations.

Prime all new work with two coats of INTERNATIONAL 300V epoxy primer.

Once the tankage below has been repaired, the deck can be repair/replaced as needed.

### 5. B-3, HOLD TANKAGE, Frames 60 1/2 - 69 (cont.)



### 5.3 B-3-4-W, Port, Reserve Feed Water Tank (cont.)



Figure 32: Forward Transverse and Boiler Support Frame within B-3-4-W



Figure 33: Aft Transverse and Boiler Support Frame within B-3-4-W

### 5. B-3, HOLD TANKAGE, Frames 60 ½ - 69 (cont.)

#### 5.4 B-3-3-W, Starboard, Reserve Feed Water Tank

Not previously inspected under the Option 1 Survey, this tank space with three transverse frames and two longitudinal frames is directly under the starboard boiler; tank transverse and longitudinal frames require extensive rebuilding and are in poor/fair structural condition with repairs required at this time. Both transverse and longitudinal support frames have plate loss in all areas averaging 50 – 70% with deflection of steel plate. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage, but with no standing water present. Forward bulkhead intact showing 40 - 50% plate loss and the aft bulkhead intact with 40- 50% plate loss with heavy rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 40% in areas of deep pitting, but is not in need of repair at this time..

Tank is sized 16' long x 24' wide.

Tank repair methodology in B-3 requires that both boilers be supported as previously discussed in #4, The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boiler will allow steel plate to be inserted into the Hold Tankage spaces to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

Tasking for B-3-3-W

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR

Crop and replace longitudinal plating (1/2" x 16'L x 4' H) on #1 longitudinal,. 64 sq. ft x 1/2"

Crop and replace longitudinal plating (1/2" x 16'L x 4' H) on #2 longitudinal. 64 sq. ft x 1/2"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 1 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 2 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 3 transverse 96 sq. ft x 3/8"

Replace four 1/2" plating knees for boiler foundations. 40 sq. ft x 3/8"

Replace two 1/2" x 4" x 10" x 24' channel beams for boiler foundations.

Prime all new work with two coats of INTERNATIONAL 300V epoxy primer.

Once the tankage below has been repaired, the deck can be repair/replaced as needed.

#### 5. B-3, HOLD TANKAGE, Frames 60 1/2 - 69 (cont.)



#### 5.4 B-3-3-W, Starboard, Reserve Feed Water Tank (cont.)



Figure 34: Forward Transverse and Boiler Support Frame within B-3-3-W



Figure 35: Transverse and Longitudinal Frames within B-3-3-W

#### 6. B-3, INNER BOTTOM TANKAGE, Frames 60 ½ - 69

Tankage within the Inner Bottom (B-90W, B-91W, B-92W & B-93W) will not be repaired under Option 5.

## **7. B-3, NAVAL ARCHITECT'S COMMENTS ON TANK REPAIRS**

### **7.1 SUSPENSION OF BOILERS WITHIN B-3**

Suspension of the boilers by the means proposed will replace the existing rotting foundations with significantly stronger material which is substantially indestructible.

Suspension of the boilers will move the point of support of these large weights from the bottom structure to the decks above. Based on the location of the boiler spaces between the forward and after turrets and barbettes means the ship will normally be in a hogging condition and the decks overhead will be in tension. Suspending the boilers would reduce the stresses in the deck, although the positive effects would be small.

### **7.2 REPAIR OF FLOOR WITHIN B-3**

Replacement of rusted and holed deck plating with solid plates would increase the strength of the lower hull in the midship area. Although the stresses would be relatively low in the static condition, they will increase as the ship lands on the proposed sand bed. Although the ship should land at the bow first, the midship section will see varying stresses with the possibility of a rip in the lower plates introducing water into the boiler rooms.

### **7.3 REPAIR TO B-3-4-W**

Replacement of weakened structure in the Port RFW tank will add stiffening to the structure under the boiler room deck. This will strengthen the lower flange of the midship section of the main hull girder and reduce the chance of failure while the ship waits on Option 5 and during the bottoming.

### **7.4 REPAIR TO B-3-3-W**

Replacement of weakened structure in the Starboard RFW tank will add stiffening to the structure under the boiler room deck. This will strengthen the lower flange of the midship section of the main hull girder and reduce the chance of failure while the ship waits on Option 5 and during the bottoming.

## **8. B-4, HOLD TANKAGE, Frames 69 – 77 ½**

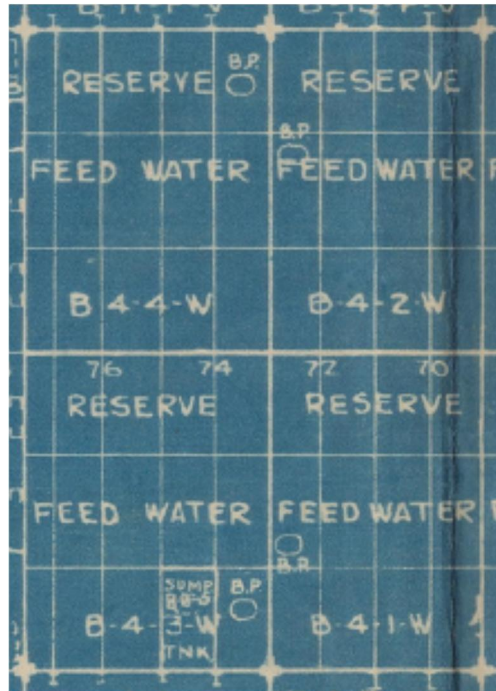


Figure 37: B-4 Hold Tankage

## 8.1 B-4-2-W, PORT RESERVE FEED WATER TANK

Not previously inspected under the Option 1 Survey, this tank space with three transverse frames and two longitudinal frames is directly under the port boiler; tank transverse and longitudinal frames require extensive rebuilding and are in poor/fair structural condition with repairs required at this time. Both transverse and longitudinal support frames have plate loss in all areas averaging 50 – 70% + with deflection of steel plate. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50%+ wastage, but with no standing water present. Forward bulkhead intact showing 40 - 50% plate loss and the aft bulkhead intact with 40- 50% plate loss with heavy rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 40% in areas of deep pitting, but is not in need of repair at this time..

Tank is sized 16' long x 24' wide.

Tank repair methodology in B-4 requires that both boilers be supported as previously discussed in #4, The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boiler will allow steel plate to be inserted into the Hold tankage space to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

Tasking for B-4-2-W

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR

## 8. B-4, HOLD TANKAGE, Frames 69 – 77 ½ (cont.)

### 8.1 B-4-2-W, PORT RESERVE FEED WATER TANK (cont.)

Crop and replace longitudinal plating (1/2" x 16'L x 4' H) on #1 longitudinal,. 64 sq. ft x 1/2"

Crop and replace longitudinal plating (1/2" x 16'L x 4' H) on #2 longitudinal. 64 sq. ft x 1/2"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 1 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 2 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 3 transverse 96 sq. ft x 3/8"

Replace four 1/2" plating knees for boiler foundations. 40 sq. ft x 3/8"

Replace two 1/2" x 4" x 10" x 24' channel beams for boiler foundations.

Prime all new work with two coats of INTERNATIONAL 300V epoxy primer.

Once the tankage below has been repaired, the deck can be repair/replaced as needed.



Figure 38: Typical Condition of Boiler Support within B-4-2-W

### 8. B-4, HOLD TANKAGE, Frames 69 – 77 1/2 (cont.)



**8.1 B-4-2-W, PORT RESERVE FEED WATER TANK (cont.)**



**Figure 39: Typical Condition of De-laminated and Holed Frames within B-4-2-W**



**Figure 40: Typical Condition within B-4-2-W**

**8. B-4, HOLD TANKAGE, Frames 69 – 77 ½ (cont.)**

## 8.2 B-4-1-W, STARBOARD, RESERVE FEED WATER TANK

Not previously inspected under the Option 1 Survey, this tank space with three transverse frames and two longitudinal frames is directly under the port boiler; tank transverse and longitudinal frames require extensive rebuilding and are in poor/fair structural condition with repairs required at this time. Both transverse and longitudinal support frames have plate loss in all areas averaging 50 – 70% + with deflection of steel plate. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50%+ wastage, but with no standing water present. Forward bulkhead intact showing 40 - 50% plate loss and the aft bulkhead intact with 40- 50% plate loss with heavy rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 40% in areas of deep pitting, but is not in need of repair at this time..

Tank is sized 16' long x 24' wide.

Tank repair methodology in B-4 requires that both boilers be supported as previously discussed in #4, The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boiler will allow steel plate to be inserted into the Hold tankage space to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

Tasking for B-4-4-W

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR

Crop and replace longitudinal plating (1/2" x 18L' x 4' H) on #1 longitudinal,. 72 sq. ft x 1/2"

Crop and replace longitudinal plating (1/2" x 18'L x 4' H) on #2 longitudinal. 72 sq. ft x 1/2"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 1 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 2 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 3 transverse 96 sq. ft x 3/8"

Crop and replace transverse plating (3/8" x 24'L x 4'H on # 4 transverse 96 sq. ft x 3/8"

Replace four 1/2" plating knees for boiler foundations. 40 sq. ft x 3/8"

Replace two 1/2" x 4" x 10" x 24' channel beams for boiler foundations.

Prime all new work with two coats of INTERNATIONAL 300V epoxy primer.

Once the tankage below has been repaired, the deck can be repair/replaced as needed.

## 8. B-4, HOLD TANKAGE, Frames 69 – 77 1/2 (cont.)

**8.2 B-4-1-W, STARBOARD, RESERVE FEED WATER TANK (cont.)**



**Figure 41: Typical Condition with Holed Plating on Overhead within B-4-1-W**



**Figure 42: Typical Condition within B-4-1-W**

**8. B-4, HOLD TANKAGE, Frames 69 – 77 ½ (cont.)**



### 8.3 B-4-4-W, PORT, RESERVE FEED WATER TANK

Not previously inspected under the Option 1 Survey, this tank space with four transverse frames and two longitudinal frames is directly under both boiler room fuel manifolds and miscellaneous components; tank components are in fair/good structural condition with no repairs required at this time. Both transverse and longitudinal support frames are intact with plate loss in areas averaging 30 – 40% with minimal deflection of steel plate. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage, but with no standing water present. Forward bulkhead intact showing 30 - 40% plate loss and the aft bulkhead intact with 40- 50% plate loss with heavy rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 40% in areas of deep pitting, but is not in need of repair at this time.



Figure 43: Typical Condition within B-4-4-W



Figure 44: Typical Condition within B-4-4-W

### 8. B-4, HOLD TANKAGE, Frames 69 – 77 ½ (cont.)



#### **8.4 B-4-3-W, STARBOARD, RESERVE FEED WATER TANK**

Not previously inspected under the Option 1 Survey, this tank space with four transverse frames and two longitudinal frames is directly under both boiler room fuel manifolds and miscellaneous components; tank components are in fair/good structural condition with no repairs required at this time. Both transverse and longitudinal support frames are intact with plate loss in areas averaging 30 – 40% with minimal deflection of steel plate. The floor of this tankage is heavily rusted/scaled with greater than 30 - 50% wastage, but with no standing water present. Forward bulkhead intact showing 30 - 40% plate loss and the aft bulkhead intact with 40- 50% plate loss with heavy rust/scale present. Vertical scantlings on both fore and aft and outboard bulkheads intact. Centerline keel plate shows plate loss of 40% in areas of deep pitting, but is not in need of repair at this time.



**Figure 45: Typical Condition of B-4-3-W**



**Figure 46: Typical Condition of B-4-3-W**

#### **9. B-4, INNER BOTTOM TANKAGE, Frames 69 – 77 1/2**

Tankage within the Inner Bottom (B-94W, B-95W, B-96W & B-97W) will not be repaired under Option 5.

## **10. B-4, NAVAL ARCHITECT'S COMMENTS ON TANK REPAIRS**

### **10.1 SUSPENSION OF BOILERS WITHIN B-4**

Suspension of the boilers by the means proposed will replace the existing rotting foundations with significantly stronger material which is substantially indestructible.

Suspension of the boilers will move the point of support of these large weights from the bottom structure to the decks above. Based on the location of the boiler spaces between the forward and after turrets and barbettes means the ship will normally be in a hogging condition and the decks overhead will be in tension. Suspending the boilers would reduce the stresses in the deck, although the positive effects would be small.

### **10.2 REPAIR OF FLOOR WITHIN B-4**

Replacement of rusted and holed deck plating with solid plates would increase the strength of the lower hull in the midship area. Although the stresses would be relatively low in the static condition, they will increase as the ship lands on the proposed sand bed. Although the ship should land at the bow first, the midship section will see varying stresses with the possibility of a rip in the lower plates introducing water into the boiler rooms.

### **10.3 REPAIR TO B-4-2-W**

Replacement of weakened structure in the Port RFW tank will add stiffening to the structure under the boiler room deck. This will strengthen the lower flange of the midship section of the main hull girder and reduce the chance of failure while the ship waits on Option 5 and during the bottoming.

### **10.4 REPAIR TO B-4-1-W**

Replacement of weakened structure in the Starboard RFW tank will add stiffening to the structure under the boiler room deck. This will strengthen the lower flange of the midship section of the main hull girder and reduce the chance of failure while the ship waits on Option 5 and during the bottoming.

## **11. INNER BOTTOM TANKAGE, Frames 77 ½ - 89**

Tankage within the Inner Bottom Tankage (B-98V, B-99V, C-90F, C-91F, C-92F & C-93F) will not be repaired under Option 5.

## 12. ENGINE ROOMS, C-1 & C-2, Frames 89 – 104

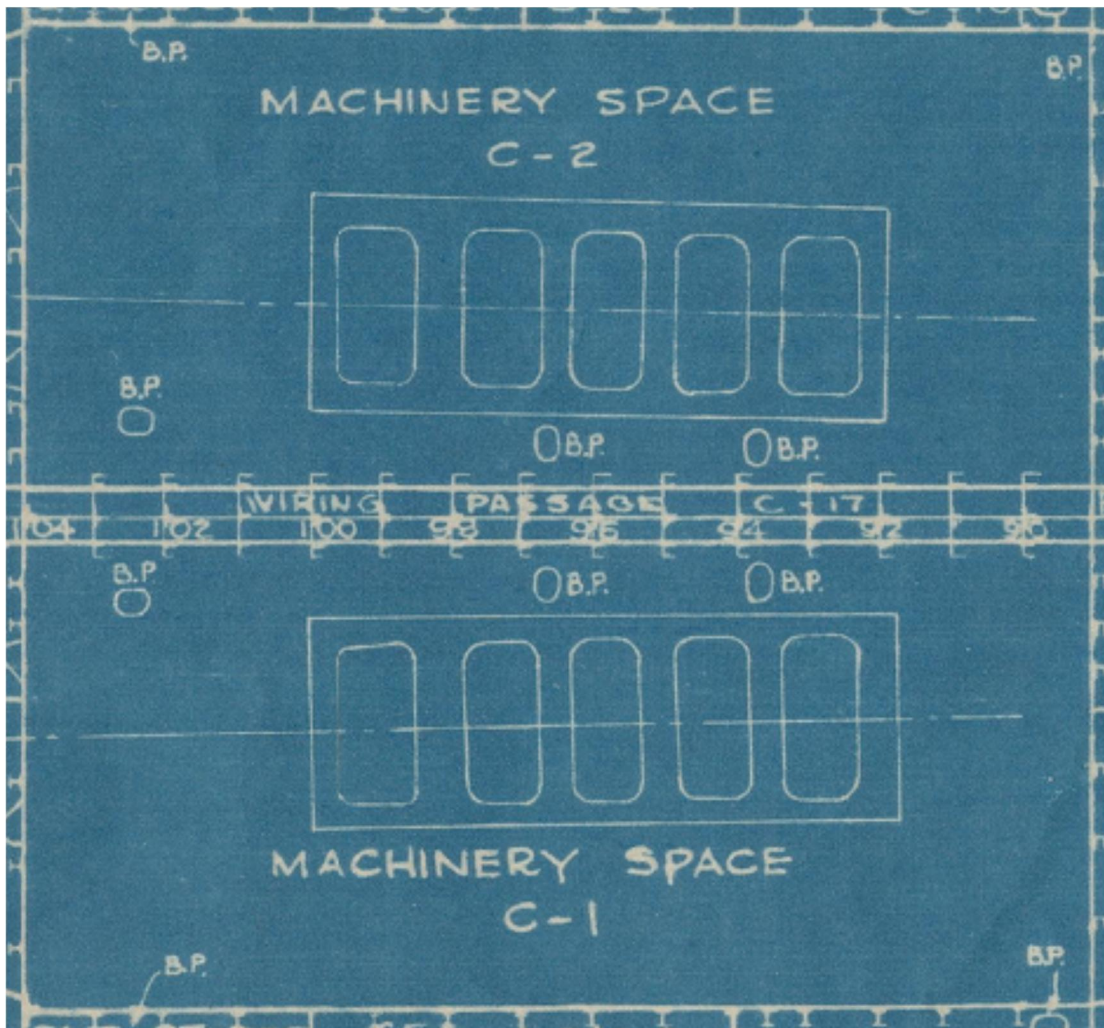


Figure 47: Engine rooms C-1 & C-2 within Hold Spaces

### 12.1 ENGINE SUPPORTS (C-1, STARBOARD & C-2, PORT)

C-1 Starboard. This space has seen extensive restoration efforts, and is open to the public. The space is well lighted, has adequate handrails and fencing containment to keep the public above the lower flats of the engine room, excellent footing and grab rods. The space is in superb cosmetic condition. All asbestos lagging has been properly remediated.

C-2 Port. This space has not seen extensive restoration efforts, and is not generally open to the public. The space is poorly lighted, has adequate handrails but poor fencing containment to keep the public above the lower flats of the engine room, excellent footing and grab rods. The space is in poor cosmetic condition. Most asbestos lagging has been properly remediated.

Of concern is the foundation for these engines in that the weight of this structure depends upon



## **12. ENGINE ROOMS, C-1 & C-2, Frames 89 – 104 (cont.)**

### **12.1 ENGINE SUPPORTS (C-1, STARBOARD & C-2, PORT) (cont.)**

the strength of the underlying trio of inner bottom tank scantlings. There is very little ‘meat’ left within the scantlings below (engine room floor, transverse frames, longitudinal frames, keel) the main engine; therefore a rebuilding of the system of bulkheads and frames (both transverse and longitudinal) for both engine rooms is appropriate. The pair of main engine base foundations have also been impacted by corrosion issues to a lesser extent.

Other major components, foundations and platforms in this space are in fine shape but all suffer from a lack of support from the inner bottom tanks. Fore and aft bulkheads for both engine rooms are holed with serious corrosion issues and must be repaired/replaced.

The schedule of tasking requires the following:

- 1) Perform any asbestos remediation on friable asbestos before any work is contemplated.
- 2) Remediate any sanding wet or dried oil on floors or other surfaces within engine room spaces prior to any hotwork.
- 3) Remove any obstructions, wiring, piping in way of lay-down area of supporting I-beams on protective deck.
- 4) Have both engine rooms and Inner Bottom Tanks cleaned and free of oil (especially C-1, C-2, C-95, C-97, & C-99F) for hot work. Contiguous tankage that requires cleaning of any/all oil residue are as follows for hot work: C-92F, C-93F, C-84F, C-86F, C-88F, D-92F, D-97F, C-85F, C-87F, C-89F, D-91F.
- 5) Map prior to removal and remove any fuel piping and appurtenances in way of Inner Bottom Tankage (vertical stanchions & gratings).

For the purposes of cost estimating, the size of the hardware used to suspend the engines is approximated. The final method of removing the load of the engines from the structure beneath will require design by a licensed engineer.

- 6) Provide twenty two (22) 2" 6 x 19 bright wire slings of suspension/support, from the armored deck above and rigid steel supports from the centerline wiring trunk and outboard bulkhead, of the triple expansion steam engine and thrust block. This system of support shall provide both vertical and lateral support for the main steam engine and thrust block. This tasking must be accomplished before any work within the Inner Bottom tanks is contemplated. Install ten (five per side) 1" x 10" steel plate brackets to support lateral support of main engine; attach to engine foundations
- 7) The main engines weigh 1,045 tons each or 2,090,000 pounds. The support for the engines can be achieved by suspending them from the armored protective deck above utilizing twenty-two (22) 2" classified 2" 6 x 19 coated or drawn galvanized bright steel cables slung under the major engine bed support components thence to the overhead deck where sistered 14 x 16 I-beams will rest on the deck with 2" x 7 threaded rod attached to the cable ends. The cable ends will be attached to 2" bright wire (as described above), coated, fiber core (FC) wire rope improved plow steel (IPC) with a breaking load of 396,000 lbs each for a total support capacity of 8,712,000 pounds of support for a safety factor of four (4). The threaded rod can be tensioned to just take the load of

## 12. ENGINE ROOMS, C-1 & C-2, Frames 89 – 104 (cont.)

### 12.1 ENGINE SUPPORTS (C-1, STARBOARD & C-2, PORT) (cont.)

the boiler off of the sub-structure allowing repairs to be made in safety. These cables include a safety factor of four (4) and will be tested with dial indicators for working loads. Section 106 remediation to put this back to original would require removal of the support gear and welding the circular holes in the armor deck back to original.

- 8) Return space(s) to original upon completion of repairs.

The drawing below pertains to the side view of the pair of I-beams for each engine resting on the armored protective deck over the main engines (both similar) in C-1 & C-2 Engine rooms.

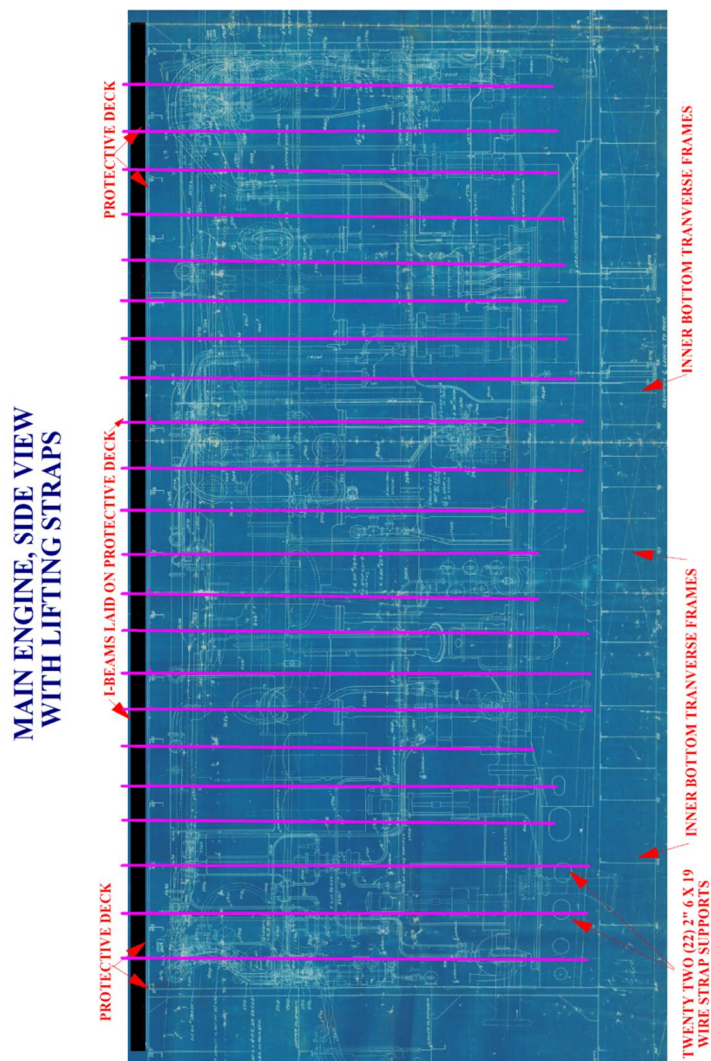


Figure 48: Side View of Main Engine with Support Wires; Typical for Both Main Engines (Hardware sizes estimated)

## 12. ENGINE ROOMS, C-1 & C-2, Frames 89 – 104 (cont.)

### 12.1 ENGINE SUPPORTS (C-1, STARBOARD & C-2, PORT) (cont.)

#### ENGINE ROOM STARBOARD LOOKING FORWARD

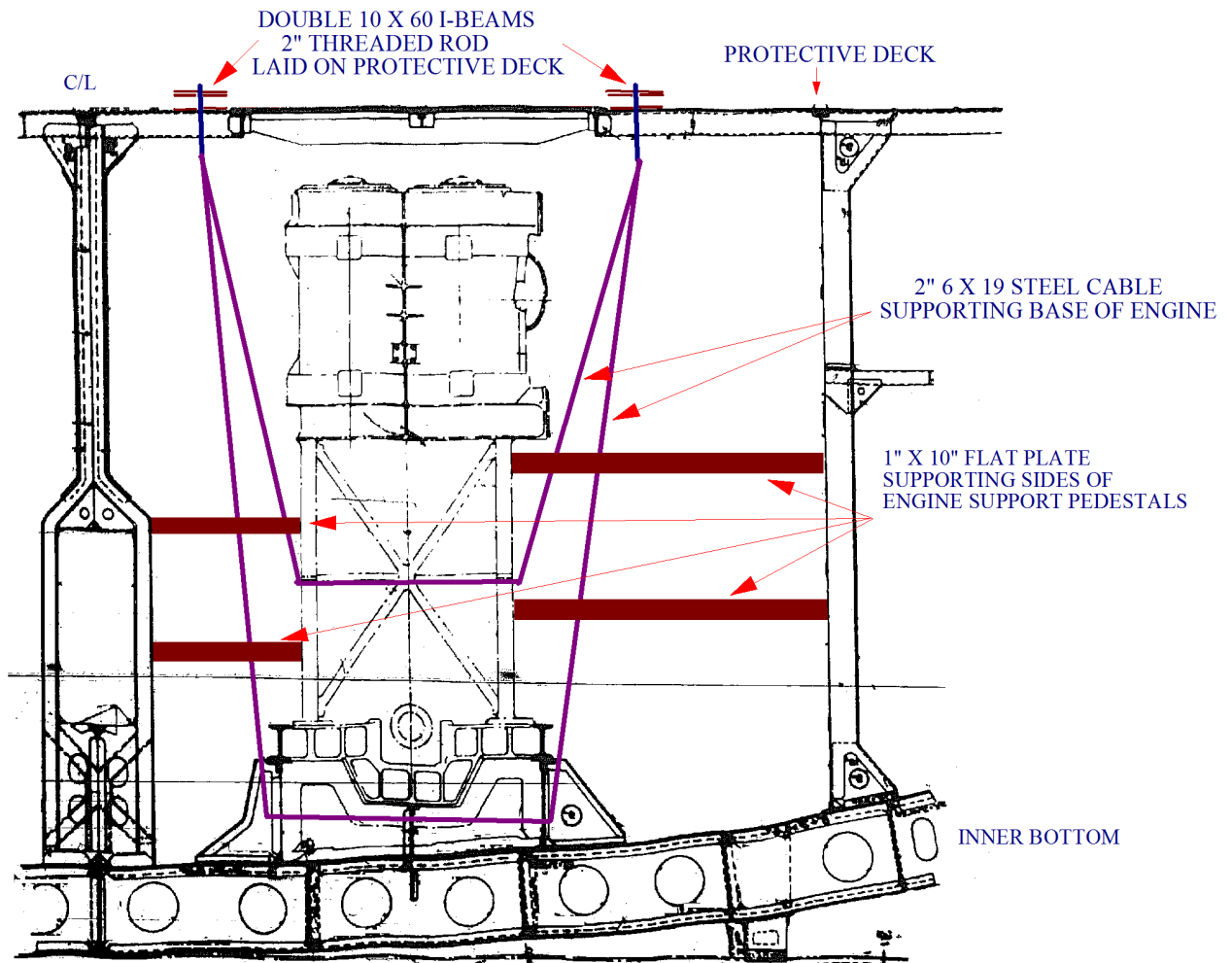


Figure 49: Starboard Main Engine, Looking Forward Showing Side Supports and Overhead Wires  
(Hardware sizes estimated)

Materials Eight 14 x 16 x 66' I-beams  
Four 2" x 32" W x 66' A-36 Flat Steel Plate  
Forty-four (44) 2" x 60' wire with eyes and fendering  
Forty-four (44) 2" classed proofed shackles, 2" classed nuts, fender washers  
Forty four (44) 2" x 3' long threaded rod with eyes



## 12.2 ENGINEROOM DECK REPLACEMENT (C-1, STARBOARD & C-2, PORT)

The deck in both Enginerooms are deteriorated and require replacement to make that space watertight

Completely photo document and record textual information about all piping, electrical and structural members in way spaces above engineroom floors for Section 106 requirements and present documentation to Project Manager.

Verify that piping is not filled with oil, remediate as needed. Remediate red lead where steel is to be cut 4" to either side of cut/welded seam per 29 CFR. Remove all piping, deck gratings, stanchions for deck gratings, minor equipment to allow access to floor plating. Remove old floors as needed. Weld 3,600 square feet of new ½" NSTM A-36 steel plate into exposed areas over Inner Bottom tankage. Prime floor with two coats of International 300V primer.

Upon completion of repairs, return all spaces to original configuration.

## 13. NAVAL ARCHITECT COMMENTS ON ENGINE SUPPORTS

The main engines are the largest individual items on the battleship and therefore must be secured such that any movement relative to the ship is impossible. The upper decks represent the sturdiest structure on the ship and are the best support for weights of this magnitude. The suspension from the overhead will safely tie the weights to the ships main hull girder. The welded plates to the centerline bulkhead and engineroom outboard bulkheads will ensure no lateral movement, completing the fixing of the two large weights in all three dimensions.

## 14. INNER BOTTOM TANKAGE, FRAMES 89 - 104

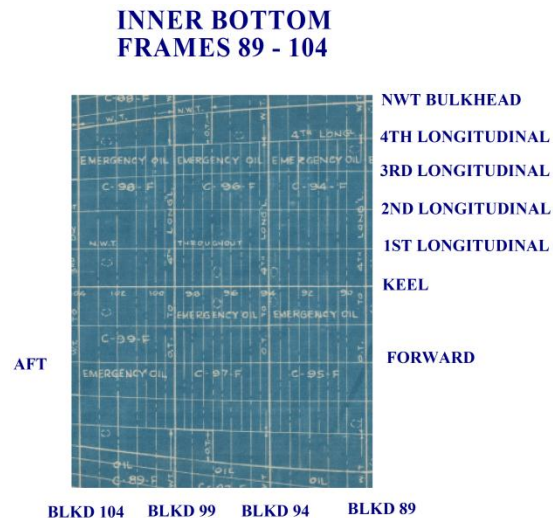


Figure 50: Inner Bottom Tankage, Frames 89 – 104

## **14. INNER BOTTOM TANKAGE, FRAMES 89 – 104 (cont.)**

### **14.1 DESCRIPTION**

These six tanks, under the pair of steam engines, are free flooding from various areas including the bottom plating.

There are six (6) fuel tanks under the pair of main triple expansion steam engines. All tanks need to be completely rebuilt with regard to transverse and longitudinal frames, transverse bulkheads and Frames 89, 94, 99, and 104. All of these main transverse bulkheads are holed and require repair. Likewise, the main longitudinals (1 -4) and transverse frames throughout are severely degraded and in some cases do not exist.

The centerline keel requires repair. Bottom plating shall not be repaired under Option #5.

### **14.2 EMERGENCY FUEL TANK, C-94F PORT**

Cut into Engineroom deck for access as needed for tank.

Crop and replace portion of forward bulkhead at Frame # 89 from keel to tank boundary. 1/2" x 4 1/2' x 40' A-36 steel plate.

Crop and replace portion of aft bulkhead at Frame # 94 from keel to tank boundary. 1/2" x 4 1/2' x 40' A-36 steel plate.

Crop and replace Longitudinals # 1 – 4 to tank boundary. 1/2" x 4 1/2' x 80' A-36 steel plate.

Crop and replace main Transverses (4) from keel to tank boundary. 3/8" x 4 1/2' x 160' A-36 steel plate

Crop & replace intermediate Transverses (4) from keel to #4 Longitudinal 3/8" x 4 1/2' x 128' A-36 steel plate

Re-install disturbed overhead deck plating to original. Prime all new surfaces with International 300V primer.

### **14.3 EMERGENCY FUEL TANK, C-95F STARBOARD**

Cut into Engineroom deck for access as needed for tank.

Crop and replace portion of forward bulkhead at Frame # 89 from keel to tank boundary. 1/2" x 4 1/2' x 40' A-36 steel plate.

Crop and replace portion of aft bulkhead at Frame # 94 from keel to tank boundary. 1/2" x 4 1/2' x 40' A-36 steel plate.

Crop and replace Longitudinals # 1 – 4 to tank boundary. 1/2" x 4 1/2' x 80' A-36 steel plate.

Crop and replace main Transverses (4) from keel to tank boundary. 3/8" x 4 1/2' x 160' A-36 steel plate

Crop & replace intermediate Transverses (4) from keel to #4 Longitudinal 3/8" x 4 1/2' x 128' A-36 steel plate.

#### **14. INNER BOTTOM TANKAGE, FRAMES 89 – 104 (cont.)**

Re-install disturbed overhead deck plating to original. Prime all new surfaces with two coats of International 300V primer.

##### **14.4 EMERGENCY FUEL TANK, C-96F PORT**

Cut into Engineroom deck for access as needed for tank.

Crop and replace portion of aft bulkhead at Frame # 99 from keel to tank boundary. 1/2" x 4 1/2' x 40' A-36 steel plate.

Crop and replace Longitudinals # 1 – 4 to tank boundary. 1/2" x 4 1/2' x 80' A-36 steel plate.

Crop and replace main Transverses (4) from keel to tank boundary. 3/8" x 4 1/2' x 160' A-36 steel plate

Crop & replace intermediate Transverses (4) from keel to #4 Longitudinal 3/8" x 4 1/2' x 160' A-36 steel plate

Re-install disturbed overhead deck plating to original. Prime all new surfaces with International 300V primer.

##### **14.5 EMERGENCY FUEL TANK, C-97F STARBOARD**

Cut into Engineroom deck for access as needed for tank.

Crop and replace portion of aft bulkhead at Frame # 99 from keel to tank boundary. 1/2" x 4 1/2' x 40' A-36 steel plate.

Crop and replace Longitudinals # 1 – 4 to tank boundary. 1/2" x 4 1/2' x 80' A-36 steel plate.

Crop and replace main Transverses (4) from keel to tank boundary. 3/8" x 4 1/2' x 160' A-36 steel plate

Crop & replace intermediate Transverses (5) from keel to #4 Longitudinal 3/8" x 4 1/2' x 160' A-36 steel plate

Re-install disturbed overhead deck plating to original. Prime all new surfaces with International 300V primer.

##### **14.6 EMERGENCY FUEL TANK, C-98F PORT**

Cut into Engineroom deck for access as needed for tank.

Crop and replace portion of aft bulkhead at Frame # 104 from keel to tank boundary. 1/2" x 4 1/2' x 40' A-36 steel plate.

Crop and replace Longitudinals # 1 – 4 to tank boundary. 1/2" x 4 1/2' x 80' A-36 steel plate.

Crop and replace main Transverses (4) from keel to tank boundary. 3/8" x 4 1/2' x 160' A-36 steel plate

Crop & replace intermediate Transverses (2) from keel to #4 Longitudinal 3/8" x 4 1/2' x 80' A-36 steel plate.



#### 14. INNER BOTTOM TANKAGE, FRAMES 89 – 104 (cont.)

Re-install disturbed overhead deck plating to original. Prime all new surfaces with International 300V primer.

#### 14.7 EMERGENCY FUEL TANK, C-99F STARBOARD

Cut into Engineroom deck for access as needed for tank.

Crop and replace portion of aft bulkhead at Frame # 104 from keel to tank boundary. 1/2" x 4 1/2' x 40' A-36 steel plate.

Crop and replace Longitudinals # 1 – 4 to tank boundary. 1/2" x 4 1/2' x 80' A-36 steel plate.

Crop and replace main Transverses (4) from keel to tank boundary. 3/8" x 4 1/2' x 160' A-36 steel plate

Crop & replace intermediate Transverses (2) from keel to #4 Longitudinal 3/8" x 4 1/2' x 80' A-36 steel plate

Re-install disturbed overhead deck plating to original. Prime all new surfaces with International 300V primer.

#### 14.8 KEEL

The keel within these Inner Bottom Tanks is badly compromised in that the vertical flat plate is badly pitted and holed throughout; the side support flanges are also badly degraded, deflected and holed. It is proposed to replace the vertical flat plate and flanges within this space.

Crop and replace vertical flat plating of keel with new 3/4" x 4 1/2' x 64' long A-36 steel plate between Frames 89 – 104.

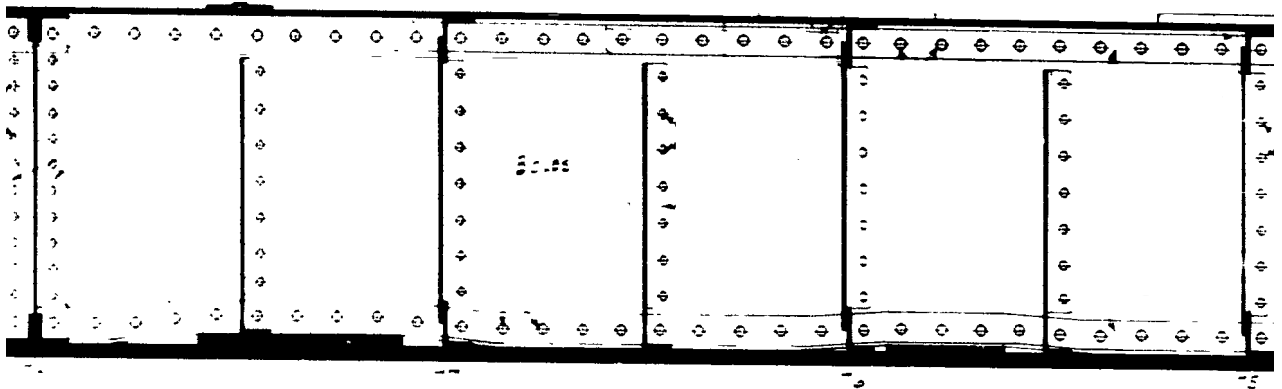


Figure 51: Detail Sampling of Flat Plate of Keel

Crop and replace diagonal support brackets (52) for keel with new 3/4" A-36 steel plate; weld to new vertical keel plate and base of old flange between every transverse frame. Re-install disturbed overhead deck plating to original. Prime all new surfaces with International 300V primer.

## 14. INNER BOTTOM TANKAGE, FRAMES 89 – 104 (cont.)

### 14.8 KEEL (cont.)

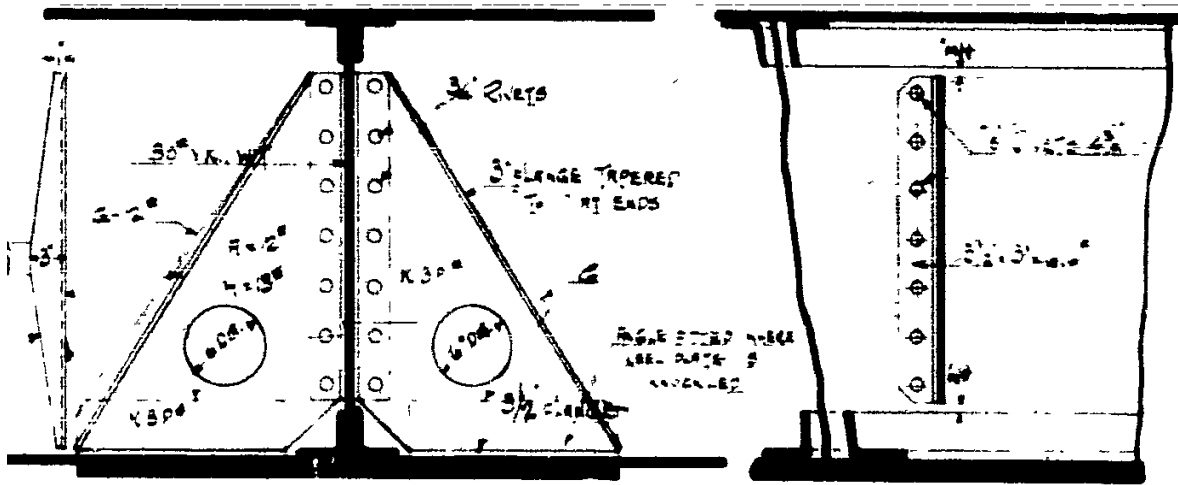


Figure 51A: Detail Sampling of End on View of Keel Showing Diagonal Support Brackets

## 15. NAVAL ARCHITECT'S COMMENTS ON INNER BOTTOM REPAIRS TO FRAMES, BULKHEADS & KEEL, FRAMES 89 -104

The bottom structure under the engine rooms represents the most important area of degraded structure on the battleship. In addition to supporting the main engines, it also ties in the structure supporting the two after turrets and barbettes. In the ship's current situation, largely bottomed out in the stern, the two turrets are supported by the residual strength in the bottom structure but mainly are cantilevered off the upper decks and the above waterline side shell.

When the ship is super-flooded and the battleship is again afloat, there is a possibility that the diminished strength in the lower flange of the hull girder in this area will fail. Even a small failure could cause the bottom and lower shell plating to buckle, allowing increased flooding at the least and possibly leading to more deflection of the ship aft of turret #3. If the stern were to sag, rebuilding the battleship to remedy the situation would present a problem too extreme to contemplate. Replacing the structure as proposed herein is the only sensible proposal.

## 16. INNER BOTTOM TANKAGE, FRAMES 104 – 115

Tankage within the Inner Bottom Tankage (D-97 & D-98V) will not be repaired under Option 5.

## 17. AFTER EMERGENCY DIESEL GENERATOR ROOM, D-11, Frames 115 – 120

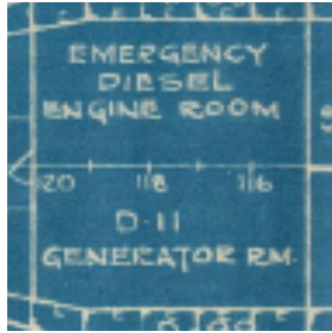


Figure 52: Aft Emergency Diesel Generator Room

This space contains the aft emergency diesel generator and switchboards. Condition of the floor and foundations for the diesel generator is poor with the possibility that the generator could fall through the floor and subsequent bottom shell plating. Forward and aft bulkhead are in poor repair with heavily corroded walls as this space was previously flooded for a long period of time.

This room is sized approximately 20' L x 24' W.

Perform oil remediation on D-11 & D-98F and make safe for 'hotwork'.

Perform asbestos & PCB remediation on this space before any work is contemplated. Perform remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR

Crop and replace approximately 180 sq. ft. of bulkhead at Frame # 115 with 3/8" A-36 steel plate.

Crop and replace approximately 180 sq. ft. of bulkhead at Frame # 120 with 3/8" A-36 steel plate.

Remove/replace wasted door frame and install new 30" x 60" dogging door at Frame # 120, aft bulkhead.

### BULKHEAD AT FRAME # 115 PLATE REPLACEMENT

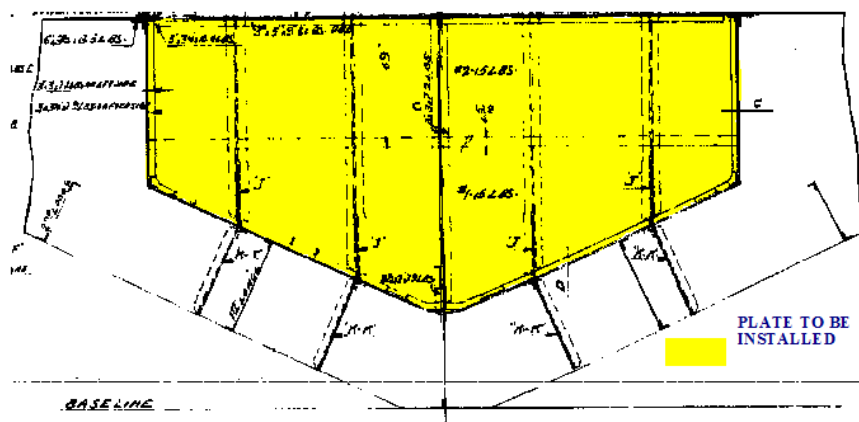


Figure 53: Forward Bulkhead in Aft Emergency Diesel Generator Room at Frame #115, Showing Plate Replacement



## 17. AFTER EMERGENCY DIESEL GENERATOR ROOM, D-11, Frames 115 – 120 (cont.)

Coat all surfaces with two coats of INTERNATIONAL 300V epoxy primer.

### BULKHEAD @ FRAME # 120 PLATE REPLACEMENT

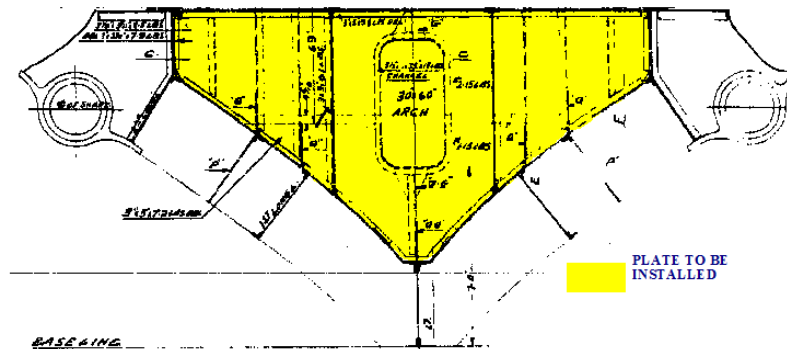


Figure 54: Aft Bulkhead in Aft Emergency Diesel Generator Room at Frame #120, Showing Plate Replacement

For the purposes of cost estimating, the size of the hardware used to suspend the diesel generator is approximated. The final method of removing the load of the diesel generator from the structure beneath will require design by a licensed engineer.

Generator weighs a maximum of 25 tons and a safety factor of four is recommended to support the diesel generator. Install four bolted pad eyes from pair of transverse frames over diesel generator. Suspend diesel generator from overhead with two 1" 6 x 19 51.7 ton nominal breaking strength classed bright wire shackled into existing 3/8" x 3" x 10" transverse frames pad eyes.

### SUSPENSION OF AFT EMERGENCY DIESEL GENERATOR FROM OVERHEAD FRAMES

PAIR OF 1" WIRES SHACKLED TO PAIR OF OVHD. TRANSVERSE FRAMES

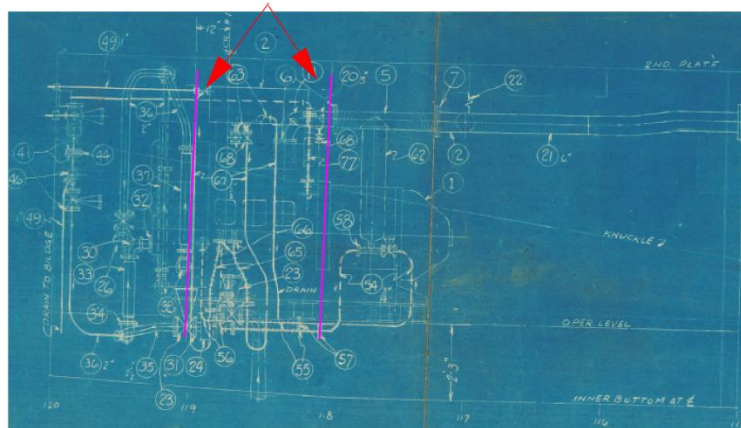
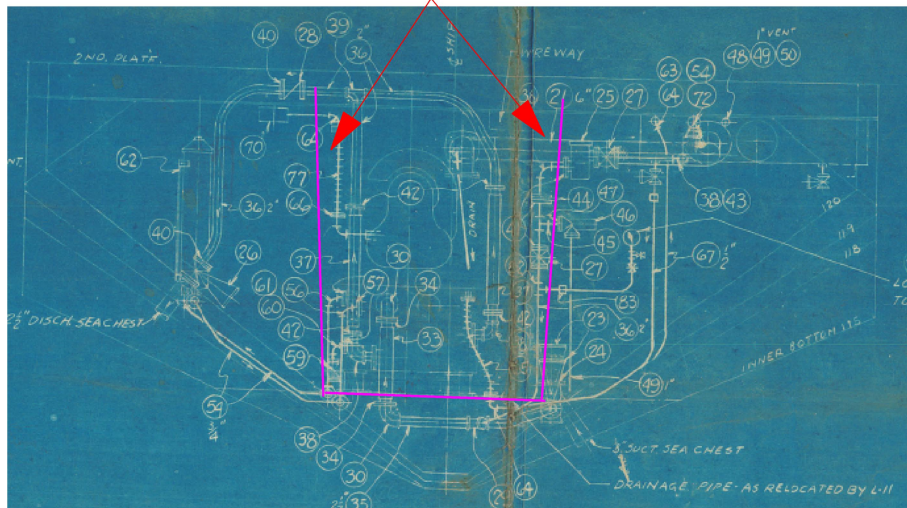


Figure 55: Side View of Aft Emergency Diesel Generator Suspended from Overhead  
(Hardware sizes estimated)

**17. AFTER EMERGENCY DIESEL GENERATOR ROOM, D-11, Frames 115 – 120  
(cont.)**

## **SUSPENSION OF AFT EMERGENCY DIESEL GENERATOR FROM OVERHEAD FRAMES**

PAIR OF 1" WIRES SUSPENDED FROM OVERHEAD TRANSVERSE FRAMES



**Figure 56: Frontal View of Aft Emergency Diesel Generator Suspended from Overhead  
(Hardware sizes estimated)**

Upon completion of suspension of diesel generator from overhead, remove any appurtenances in way of work which may include piping, wire trunks and other equipment resting on floors.

Upon completion of repairs to Inner Bottom Tank D-99F, insert new 3/8" A-36 steel deck to Aft Emergency Diesel generator Room. Crop out existing wasted deck and install 500 sq. ft of 3/8" A-36 steel decking.

Prime all new surfaces with two coats of International 300V primer.



**Figure 57: Aft side of Emergency Diesel Generator in D-11**



### 19. VOID SPACE, D-99, Frames 115 – 122 (cont.)

Crop and replace transverse plating (3/8" x 30'L x 4'H on # 1 transverse	120 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 30'L x 4'H on # 2 transverse	120 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 30'L x 4'H on # 3 transverse	120 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 30'L x 4'H on # 4 transverse	120 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 28'L x 4'H on # 5 transverse	112 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 28'L x 4'H on # 6 transverse	112 sq. ft x 3/8"
Crop and replace vertical flat plating of keel with new 3/4" x 4 1/2' x 24' long A-36 steel plate between Frames 115 - 120.	

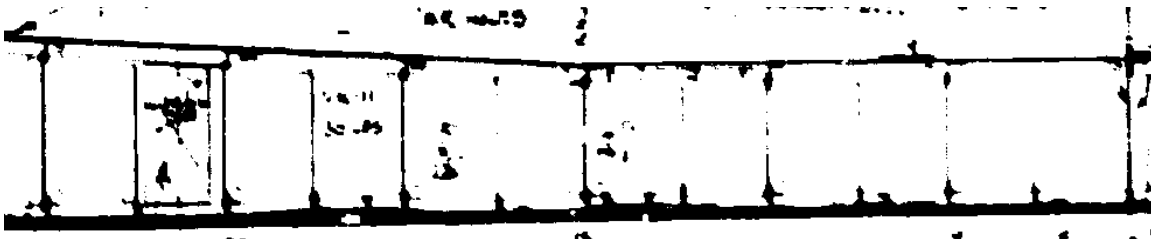


Figure 59: Detail Sampling of Flat Plate of Keel within D-99V from Frames 115 - 120

Crop and replace diagonal support brackets (26) for keel with new 3/4" A-36 steel plate; weld to new vertical keel plate and base of old flange between every transverse frame.

Crop out and replace both forward and aft bulkhead of tank with, approx. 300 sq. ft of 3/8" A-36 steel plate.

Prime all new work with two coats of INTERNATIONAL 300V epoxy primer.

Once the tankage below has been repaired, the deck can be repair/replaced as needed.

### 20. NAVAL ARCHITECT'S COMMENTS ON REPAIRS TO VOID D-99V, Frames 115 – 122

Replacement of the degraded structure will permit maintaining the shape of the stern and allow the bottoming of the battleship in Option 5 without the possibility of "crumpling" the aft end.



## 21. DISCUSSION OF REPAIRS TO AFT END OF SHIP, FRAMES 122 – AFT PERPENDICULAR

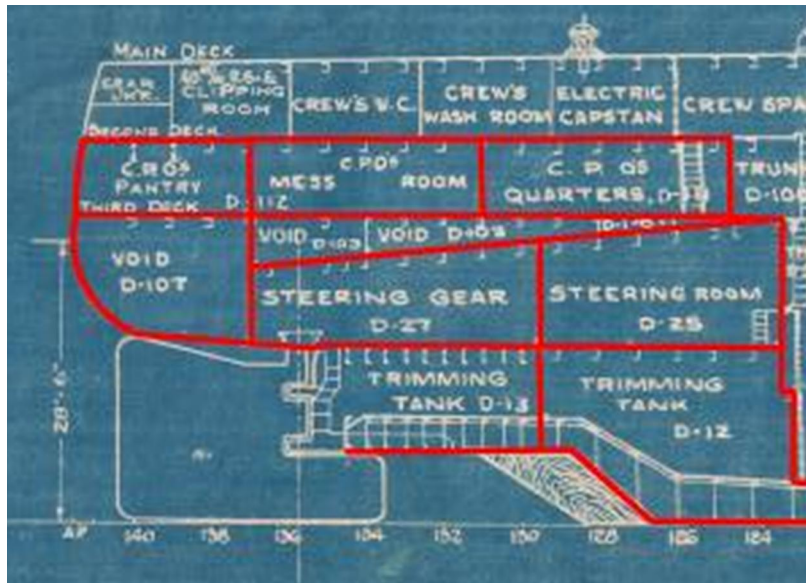


Figure 60: Detail of Stern Repair Area

The Hull Survey conducted in December 2010 – January 2011 and the latest inspection of January 2012 revealed serious degradation in the aft area of the ship from Frame 123 to the stern, this area of degradation extended upward from the keel, side shell transverse frames, bulkheads and vertical stanchions up to the bottom of the 2<sup>nd</sup> Deck.

The following repairs propose to remedy this situation and afford ample strength for the vessel when she if super-flooded and, later, set down on the hard within the Option 5 berm. The schedule of repairs commences from the keel upward and outward to the bottom of the 2<sup>nd</sup> Deck and will be labeled deck-by-deck for easiest understanding. Shell plate leakage will be addressed once main transverse frames are installed in order to give the fabricators something to tie steel cofferdam to between frames. This schedule of repairs is how this type of restoration would be performed and allow strength to support upper deck weights in a systematic way.

## 22. 2<sup>ND</sup> PLATFORM & HOLD , TRIMMING TANK (D-12) & STOREROOMS OUTBOARD OF STEERING ROOM (D-25), Frames 122 – 129

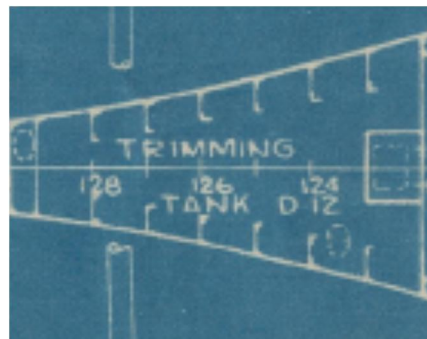


Figure 61: Trimming Tank, D-12

## **22. 2<sup>ND</sup> PLATFORM & HOLD , TRIMMING TANK (D-12) & STOREROOMS OUTBOARD OF STEERING ROOM (D-25), Frames 122 – 129 (cont.)**

This trimming tank is a large open space with fore and aft bulkheads and main transverse frames and vertical steel stanchions supporting the overhead. Much of the support framing and all of the stanchions require replacement. The bulkheads, likewise, require replacement.



**Figure 62: Typical Main Transverse and Longitudinal Frame in D-12 Trimming Tank**



**Figure 63: Wasted Longitudinal and Transverse Frames to Starboard between Frame 122 – 124.  
Notice Seepage and Run-off from Leaking Shell Plating in D-12 Trimming Tank.**



## 22. 2<sup>ND</sup> PLATFORM & HOLD, TRIMMING TANK (D-12) & STOREROOMS OUTBOARD OF STEERING ROOM (D-25), Frames 122 – 129 (cont.)

Crop and replace longitudinal plating (1/2" x 28L' x 2' H) on #3 longitudinal,	70 sq. ft. x 1/2"
Crop and replace longitudinal plating (1/2" x 28L' x 2' H) on #4 longitudinal,	70 sq. ft. x 1/2"
Crop and replace transverse plating (3/8" x 30'L x 2'H) on Frame 123 transverse	60 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 30'L x 2'H) on Frame 124 transverse	60 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 30'L x 2'H) on Frame 125 transverse	60 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 30'L x 2'H on Frame 126 transverse	60 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 28'L x 2'H on Frame 127 transverse	60 sq. ft x 3/8"
Crop and replace transverse plating (3/8" x 28'L x 2'H on Frame 128 transverse	60 sq. ft x 3/8"
Crop and replace floors in D-26P & D-26S	
Install interior cofferdam plating between Transverse Frames 122 and 129 from overhead to keel to contain shell plate leaks.	1,680 sq. ft x 1/4"
Coat all new work with two coats of INTERNATIONAL 300V primer.	

### TRANSVERSE FRAMES 123, 124, 125 & 126 D-26P, D-26S & D-12 TRIMMING TANK

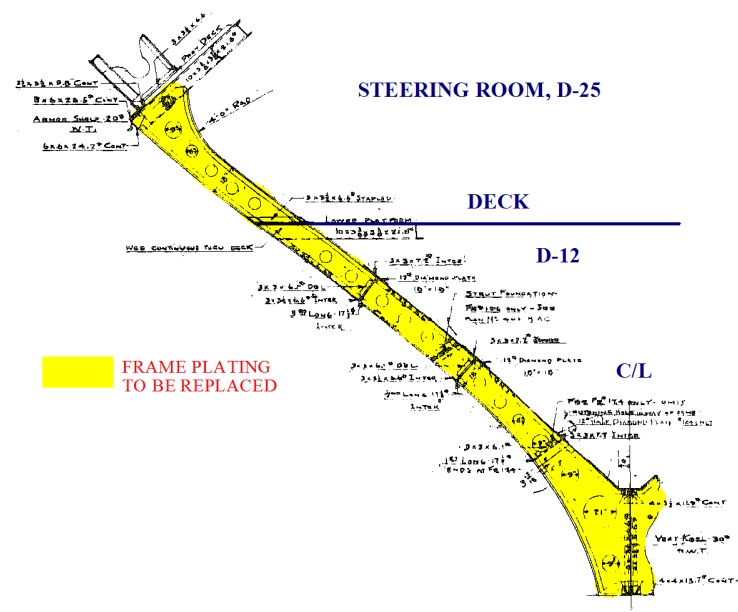


Figure 65: Transverse Frames 123 – 126 in D-26P, D-26S & D-12 Trimming Tank



22. 2<sup>ND</sup> PLATFORM, HOLD, TRIMMING TANK (D-12) & STOREROOMS  
OUTBOARD OF STEERING ROOM (D-25), Frames 122 – 129 (cont.)

TRANSVERSE FRAME # 127  
D-26P, D-26S & D-12

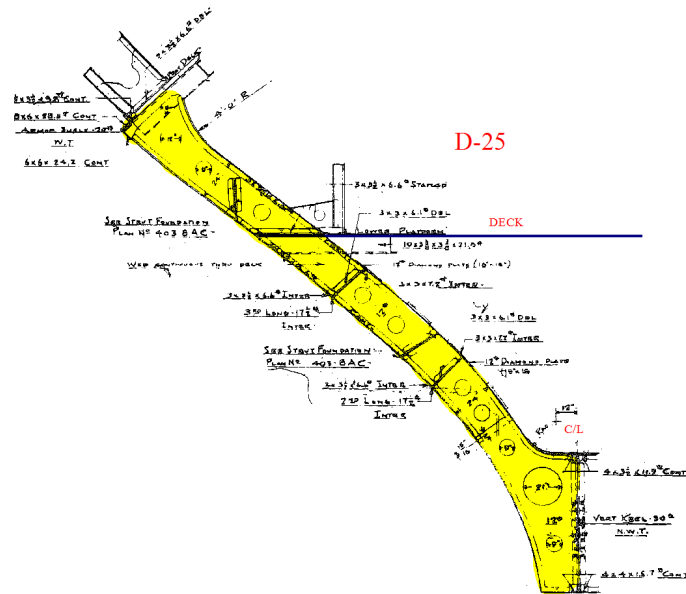


Figure 66: Transverse Frames 127 in D-26P, D-26S & D-12 Trimming Tank

TRANSVERSE FRAME # 128  
D-26P, D-26S, & D-12

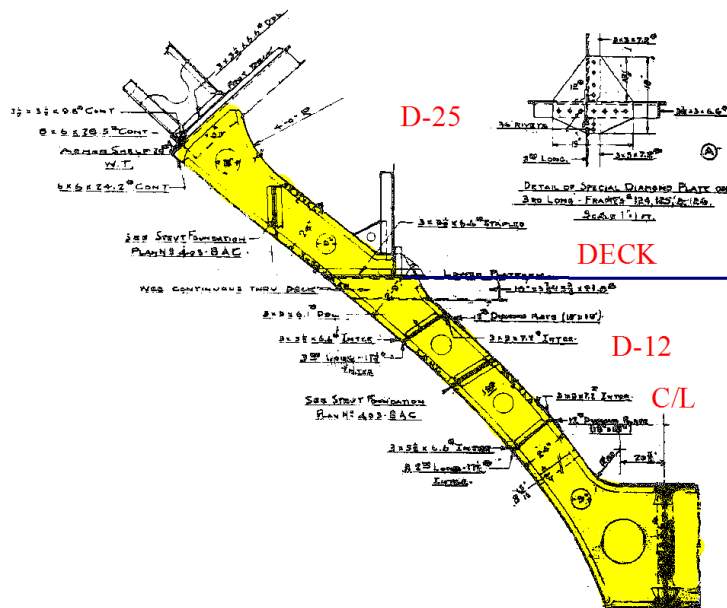


Figure 67: Transverse frames 128 in D-26P, D-26S & D-12 Trimming Tank

22. 2<sup>ND</sup> PLATFORM, HOLD, TRIMMING TANK (D-12) & STOREROOMS  
OUTBOARD OF STEERING ROOM (D-25), Frames 122 – 129 (cont.)

BULKHEAD & TRANSVERSE FRAME # 129

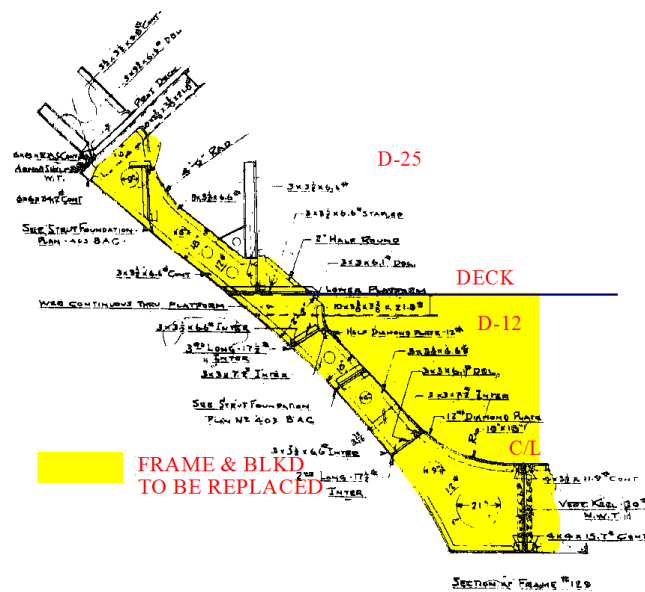


Figure 68: Transverse Frame 129 and Bulkhead in D-26P, D-26S & D-12 Trimming Tank

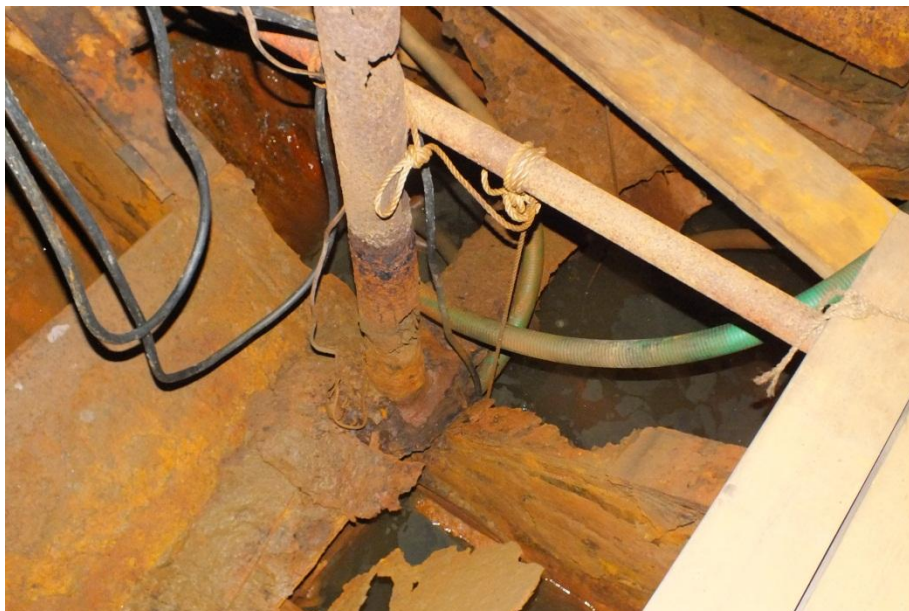


Figure 69: Base of Centerline Wasted Stanchion Resting on Wasted Pedestal over Keel in D-12 Trimming Tank

**23. NAVAL ARCHITECT'S COMMENTS ON REPAIRS TO 2<sup>ND</sup> PLATFORM, HOLD, TRIMMING TANK (D-12) & STOREROOMS OUTBOARD OF STEERING RAM ROOM (D-25), Frames 129 – 137**

Rebuilding Trim Tank D-12 and the storerooms will stiffen the aft end of the keel and ensure that if the battleship is not trimmed by the bow and does land on the aft end of the keel, it will not collapse. At the moment, it would not take much force in the area of Frame 129 to crush the severely degraded structure.

**24. 2<sup>ND</sup> PLATFORM & HOLD, TRIMMING TANK D-13, STEERING GEAR ROOM D-27, Frames 129 - 137**

The Trimming Tank D-13 is accessed via a dogging scuttle to port in the Steering Ram Room. This space has much degradation within the transverse frames; however, the frames are on 2' centers and keel area looks to be in excellent shape all the way aft to the stern casting; very strong area of support for rudder and stern overhang. The keel is in good repair showing just 30 – 40 % wastage and will not be the subject of any repairs at this time.

The overhead frames and deck are in poor to fair condition and will be replaced as the heavy steering rams and rudder post ride on this deck.



**Figure 70: D-13 Trimming Tank, looking forward to Bulkhead at Frame 129**



**Figure 71: D-13 Trimming Tank, looking Aft to Stern Casting**



#### **24. 2<sup>ND</sup> PLATFORM & HOLD, TRIMMING TANK D-13, STEERING GEAR ROOM D-27, Frames 129 – 137 (cont.)**

The Steering Gear Room (D-27) sits atop the Trimming Tank (D-13) and is an open area with the heavy hydraulic components of the steering rams and rudder post. The deck is in poor condition and must be replaced. The bottom 4' of the side shell transverse frames are also in need of repair/replacement.



**Figure 72: Typical Base of Transverse Frame within D-27**



**Figure 73: Heavy Steering Rams and Rudder Post in D-27**



## 24. 2<sup>ND</sup> PLATFORM & HOLD, TRIMMING TANK D-13, STEERING GEAR ROOM D-27, Frames 129 – 137 (cont.)

The schedule of repairs for D-27 is as follows:

Install adequate lighting for entire compartment.

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR.

Crop and replace bottom 5' of plating on Transverse Frames 130 - 133 through-  
out D-27 with new 3/8" A-36 plating and match frame profiles 160 sq. ft. x 3/8" plate

For the purposes of cost estimating, the size of the hardware used to suspend the steering gear is approximated. The final method of removing the load of the steering gear from the structure beneath will require design by a licensed engineer.

Suspend steering rams (100 tons) from overhead 3/8" x 4" x 10" channel trans-  
verse frames with four 1 1/2" 6 x 19 classed bright improved plow steel IRWC  
wire with a nominal strength of 114 tons with a safety factor of four (4).

Four (4) 15' 1 1/2" 6 x 19 classed bright improved plow steel IRWC wire with eyes  
Eight (8) classed 1 1/2" shackles  
Eight 1 1/2" steel pads with 3" eyes to mount to overhead frames

Crop and replace bottom plating on Transverse Frames 134 - 136 and base half  
Frames under rudder crosshead with new 1/2" A-36 plating and match frame  
profiles 160 sq. ft. x 1/2" plate

Replace aft Bulkhead at Frame 137. 80 sq. ft. x 1/2" plate

Upon suspension of steering gear, crop and replace deck throughout compartment  
with new 1/2" A-36 steel plate. 400 sq. ft. of 1/2" plate

Coat all new work with two coats of INTERNATIONAL 300V Primer.



Figure 74: Badly Corroded Scantlings Aft of Rudder Post

## **25. NAVAL ARCHITECT'S COMMENTS ON REPAIRS TO 2<sup>ND</sup> PLATFORM, HOLD, TRIMMING TANK (D-13) & STEERING RAM ROOM (D-27), Frames 129 – 137**

With respect to the steering gear rams and equipment it is necessary to suspend the weights from the Second Deck in order to safely replace the deteriorated foundations. Rebuilding the foundations will ensure these large weights do not tear loose and fall through the ships bottom.

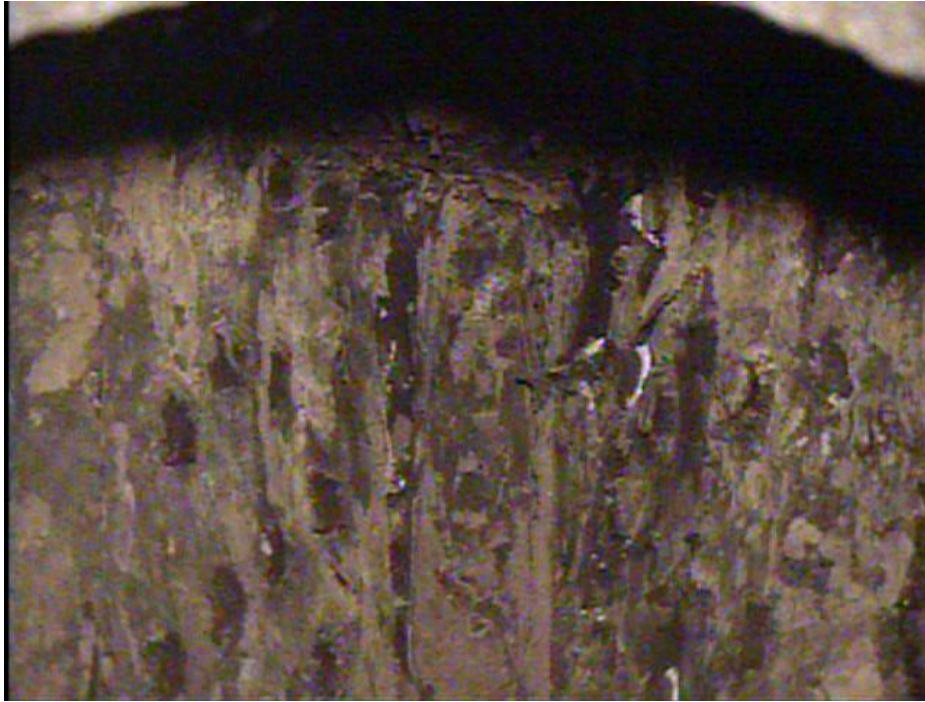
## **26. 2<sup>nd</sup> PLATFORM VOID D-107, FRAMES 137 – AFT PERPENDICULAR**

A large space just aft of the rudder post at the very stern of the ship. This space has large apron frames from top to bottom within this tank. All scantlings are heavily corroded due to poor drainage from weatherdecks. There are holes in the shell plating above the waterline to the exterior and cofferdam tankage above is heavily wasted and badly corroded.



**Figure 75: Upper Portion of D-107, showing Heavily Corroded Scantlings**

**26. 2<sup>nd</sup> PLATFORM VOID D-107, FRAMES 137 – AFT PERPENDICULAR (cont.)**



**Figure 76: Stern Casting, showing Daylight through Wasted and Holed Shell Plating on Centerline above Waterline**



**Figure 77: Heavily Wasted Transverse Frame at Base of Compartment**



## 26. 2<sup>nd</sup> PLATFORM VOID D-107, FRAMES 137 – AFT PERPENDICULAR (cont.)

The schedule of repairs for D-107 is as follows:

Install adequate lighting for entire compartment.

Remediation of red lead where steel is to be cut 4” to either side of cut per 29 CFR.

Crop and replace plating on Transverse Frames 136 – 140 through-out D-27 with new 3/8” A-36 plating and match frame profiles	200 sq. ft x 3/8” plate
--	-------------------------

Crop out and replace three transverse bulkhead frames in base of compartment with new 3/8” A-36 plating and match frame profiles	140 sq. ft. x 3/8” plate
--	--------------------------

Install interior cofferdam plating between Transverse Frames 137 and 141 from overhead to keel to contain shell plate leaks.	600 sq. ft x 1/4” plate
--	-------------------------

Install 1/4” A-36 doubler plate over holed plating on transom above waterline.	300 sq. ft x 1/4” plate
--	-------------------------

Coat all new work with two coats of INTERNATIONAL 300V Primer.

## 27. NAVAL ARCHITECT’S COMMENTS ON REPAIRS TO 2<sup>ND</sup> PLATFORM VOID D-107, FRAMES 137 – AFT PERPENDICULAR

Most of the structural elements in this area are firmly attached at the overhead and become progressively more deteriorated as you move deeper into the ship. That it has not already been torn apart is almost solely due to the fact that the only force on the steel is gravity. If the ship were afloat and attempting to steam and maneuver, it is likely that the entire stern would have collapsed.

## 28. VOIDS D-101, D-102, D-103, FRAMES 123 - 137

These three void spaces (tapered in ascending height from forward to aft) are located directly over both the Steering Room and Steering Gear Room. These crawl spaces comprise the turtleback cover to the Steering Flats.

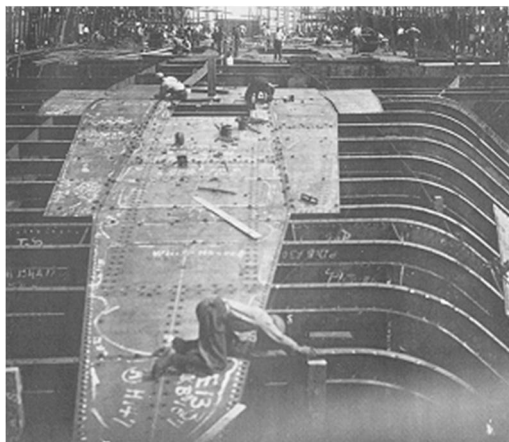


Figure 78: Building the Void Spaces D-101, D-102 & D-103<sup>1</sup>

<sup>1</sup> Photo courtesy of Texas parks & Wildlife (TPWD).



**28. VOIDS D-101, D-102, D-103, FRAMES 123 – 137 (cont.)**



**Figure 79: D-101 looking Forward to Port**



**Figure 80: D-102. Looking across Turtle back to Starboard Showing Wasted Vertical Stanchions**

**28. VOIDS D-101, D-102, D-103, FRAMES 123 – 137 (cont.)**



**Figure 81: Wasted Vertical Stanchion. Typical throughout D-101, D-102 & D-103.**



**Figure 82: Wasted Vertical Stanchion**

## 28. VOIDS D-101, D-102, D-103, FRAMES 123 – 137 (cont.)

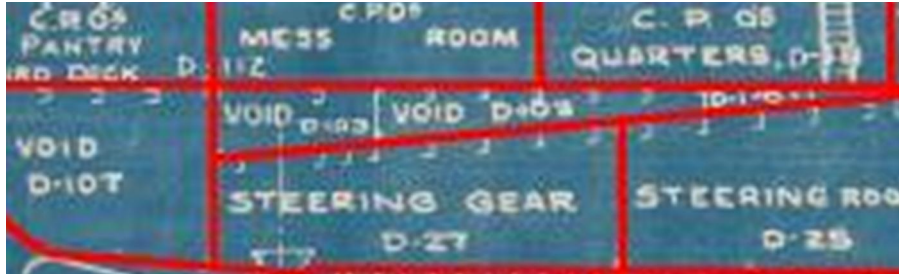


Figure 83. Detail of Voids D-101, D-102, D-103

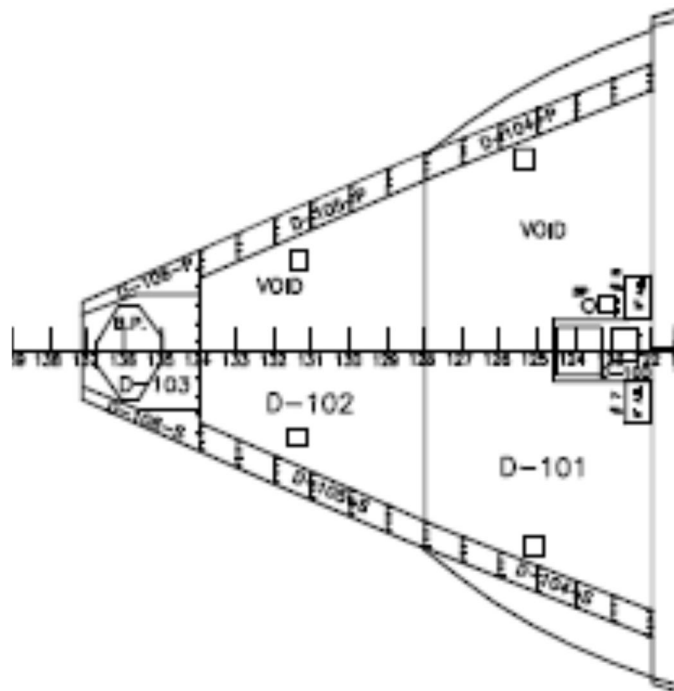


Figure 84: Bird's Eye View of Voids D-101, D-102 & D-103

Install adequate lighting for entire compartment.

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR.

Crop and replace forty-eight (48) vertical stanchions through-out D-101, D-102 & D-103.

48 x 3/8" x 6" x 6" I-beams

Crop out and replace ninety-six (96) stanchion bases 1" steel pads throughout D-101, D-102 & D-103.

96 x 1" x 8" x 8" steel plate

Crop out and replace wasted bulkheads at Frame # 134 & # 137.

Coat all new work with two coats of INTERNATIONAL 300V Primer.



## 29. NAVAL ARCHITECT'S COMMENTS ON REPAIRS TO VOIDS D-101, D-102, D-103, FRAMES 123 – 137

The structure above the Third Deck provides stiffening to the Second Deck and will strengthen the stern area if the ship unexpectedly lands with stern trim. Added structure in this area will help support the steering rams and other equipment in the steering gear room.

## 30. THIRD DECK, CPO QUARTERS D-111, CPO MESS ROOM D-112, CPO PANTRY D-113

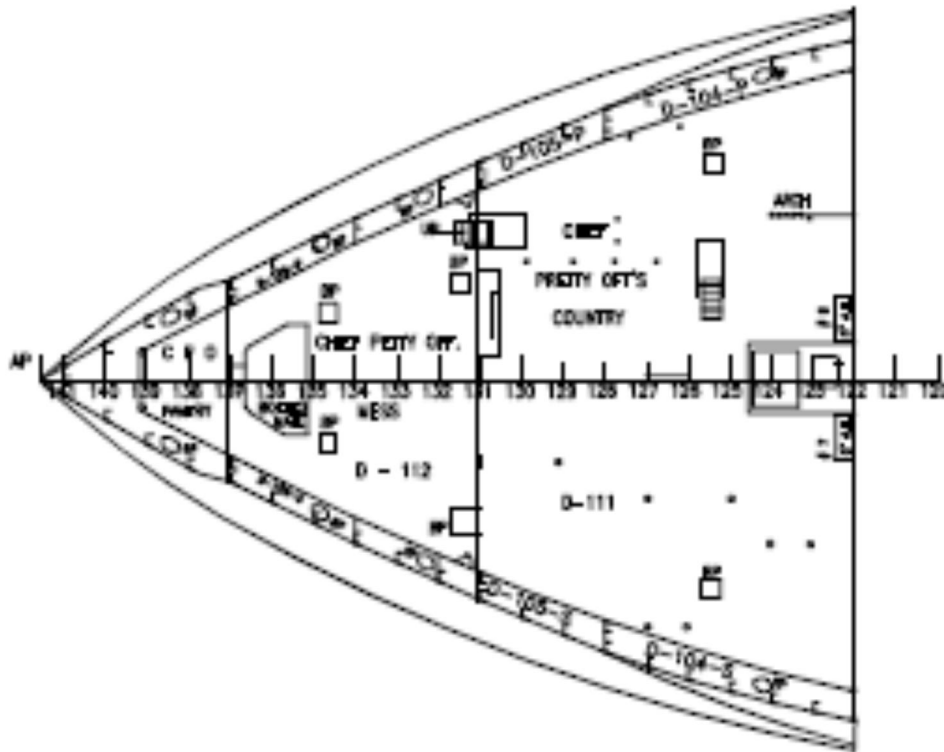


Figure 85: Bird's eye view of D-111, D-112 & D-113

This space contained berthing and clothing storage and is a side-to-side wide open space with vertical stanchions supporting the base of the 2<sup>nd</sup> Deck. Many of the vertical stanchions in this space are degraded and must be replaced, a serious structural issue. The deck itself is badly corroded pointing to past standing water from poor drainage from upper decks.

The tank tops on the exterior skin of the vessel are 'swiss cheese' and are badly corroded; internal scantlings for the cofferdam spaces outboard are badly corroded, but are not considered a threat to the structural integrity of the ship at this time.

Forward and aft vertical steel bulkheads at Frames # 122 & # 131 are seriously corroded, particularly at the deck line and do not provide any vertical support to the 2<sup>nd</sup> Deck.



**30. THIRD DECK, CPO QUARTERS D-111, CPO MESS ROOM D-112, CPO PANTRY D-113 (cont.)**

**D-111**

Install adequate lighting for entire compartment.

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR.

Crop and replace six (6) 5" O.D. x 1/2" wall vertical stanchions in D-111 6 x 5" O.D. x 86" stanchions

Crop out and replace twelve (12) stanchion bases 1" steel pads in D-111 12 x 1" x 8" x 8" steel pads

Crop out and replace wasted bottom 3' bulkheads at Frame # 134 & # 137. 370 sq. ft. of 3/8" A-36 plate

Coat all new work with two coats of INTERNATIONAL 300V Primer.



**Figure 86: Looking to Starboard in D-111**



**Figure 87: Wasted Stanchion Base in D-111**

**30. THIRD DECK, CPO QUARTERS D-111, CPO MESS ROOM D-112, CPO PANTRY D-113 (cont.)**

**D-112**

Install adequate lighting for entire compartment.

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR.

Crop and replace three (3) 5" O.D. x 1/2" wall vertical stanchions in D-112      3 x 5" O.D. x 86" stanchions

Crop out and replace six (6) stanchion bases 1" steel pads in D-111      12 x 1" x 8" x 8" steel pads

Crop out and replace wasted bottom 3' bulkheads at Frame # 137.      150 sq. ft. of 3/8" A-36 plate

Coat all new work with two coats of INTERNATIONAL 300V Primer.



**Figure 88: D-112 CPO Mess Space**



**Figure 89: Wasted Stanchion Base in D-112**

**30. THIRD DECK, CPO QUARTERS D-111, CPO MESS ROOM D-112, CPO PANTRY D-113 (cont.)**

**D-113**

Install adequate lighting for entire compartment.

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR.

Crop and replace two (2) 5" O.D. x 1/2" wall vertical stanchions in D-113      2 x 5" O.D. x 86" stanchions

Crop out and replace four (4) stanchion bases 1" steel pads in D-113      4 x 1" x 8" x 8" steel pads

Crop out and replace wasted deck in C-113.      50 sq. ft. of 3/8" A-36 plate

Coat all new work with two coats of INTERNATIONAL 300V Primer.



**Figure 90: Looking to Starboard in D-113**



**Figure 91 Looking to Aft in D-113**

### **31. NAVAL ARCHITECT'S COMMENTS ON REPAIRS TO THIRD DECK, CPO QUARTERS D-111, CPO MESS ROOM D-112, CPO PANTRY D-113**

The large weight concentrations on the fantail, especially the 40mm gun mounts and gun shields, are almost solely being supported by the Second and Main Decks cantilevered off the forward portion of the ship. In order to avoid the possibility of the stern sagging it is necessary to restore the support of the fantail to the below deck structure. Although this area will not be supported by the sand in Option 5, it will lose the support of the buoyancy of the water, which is substantial.

### **32. SUMMARY**

This report attempts to put repairs that are required for the Option 5 proposal into perspective with regard to sequencing of repairs, materials required and estimated costs for this progression.

The costs for the tasking described within the body of this report is attached within the Appendix.

The repairs that have been described are not the total of work that needs to be accomplished under Option 5, but represents approximately a 70% threshold of repairs estimated needed to carry out this progression. Further inspection of tankage out to the sides of the ship, up to the waterline and blister tank inspections were not carried out and there remains questions about the viability of keeping the hull watertight during the super-flooding process.

Section 106 concerns are mostly surrounding cuts to be made for access to spaces; the solution for any and all concerns in this area is to put the area back to the appearance and condition before work/remediation commenced.

Repairs have been kept to the absolute minimum, but are thorough where structural rigidity is needed.

Respectfully submitted,



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Joseph Lombardi  
Marine Surveyor



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Jerry Possehl  
Naval Architect



## **33. APPENDIX**

## SUMMARY OF TASKING

Task #4	\$ 1,379,718.00
Task 5.3 B-3-4-W, Port, Reserve Feed Water Tank	222,400.00
Task 5.4 B-3-3-W, Starboard, Reserve Feed Water Tank	222,400.00
Task 8.1 B-4-2-W, Port, Reserve Feed Water Tank	251,200.00
Task 8.2 B-4-3-W, Starboard, reserve Feed Water Tank	251,200.00
Task 12.1 C-1 & C-2	1,556,076.00
Task 12.2 Replacement of C-1 & C-2 Engineroom Deck	2,745,000.00
Task 14.2 C-94F, Emergency Fuel Tank	1,027,800.00
Task 14.3 C-95F, Emergency Fuel Tank	1,027,800.00
Task 14.4 C-96F, Emergency Fuel Tank	1,062,000.00
Task 14.5 C-97F, Emergency Fuel Tank	1,062,000.00
Task 14.6 C-98F, Emergency Fuel Tank	900,000.00
Task 14.7 C-99F, Emergency Fuel Tank	900,000.00
Task 14.8 Keel	503,400.00
Task 17 D-11 Aft Emergency Diesel Generating Room	438,315.00
Task 19 D-99V	639,200.00
Task 22 D-12 Trimming Tank	1,150,570.00
Task 24 D-13 & D-27 Steering Gear Room	491,025.00
Task 26 Void D-107	449,500.00
Task 28 Voids, D-101, D-102, D-103	342,650.00
Task 30.1 CPO Berthing D-111	180,695.00
Task 30.2 CPO Mess D-112	80,117.00
Task 30.3 CPO Pantry D-113	40,128.00
<b>Total</b>	<b>\$ 16,923,194.00</b>
<b>General Conditions</b>	<b>575,000.00</b>
Contractor mob/demob with 40' x 110' spud barge, 100 ton crane, 35 ton crane, pusher tug, two 200 kw generators, one flatbed trailer, one Hyster fork truck, six welding machines, six oxy/acetylene units, one contractor trailer, power, phones, two Porti-Pottis	450,000.00
<b>General Liability Insurance</b>	<b>55,000.00</b>
<b>Builder's Risk Insurance</b>	<b>32,500.00</b>
<b>Total</b>	<b>\$ 18,035,694.00</b>
<b>Bonds (2%)</b>	<b>360,713.88</b>
<b>Total</b>	<b>\$ 18,396,407.88</b>
<b>Profit &amp; Overhead 15%</b>	<b>2,759,461.35</b>
<b>Total Cost of Project</b>	<b>\$ 21,155,869.23</b>

**TASKING****ESTIMATED  
COST****Task 4****Tasking for Boiler Rooms # 3 & # 4, Frames 60 1/2 - 77 1/2**

For the purposes of cost estimating, the size of the hardware used to suspend the boilers is approximated. The final method of removing the load of the boilers from the structure beneath will require design by a licensed engineer.

The support for the boilers can be achieved by suspending them from the armor deck above utilizing steel cable fastened to 24" wide x 30' long double, 2 ply nylon straps (for supporting the underneath of the boiler) thence to the overhead deck where sistered 10 x 60 I-beams will rest on the deck with 1.25 x 7 threaded rod attached to the cable ends. The cable ends will be attached to 1.25" bright wire, uncoated, fiber core (FC) wire rope improved plow steel (IPC) with a breaking load of 129,200 lbs down to the nylon straps. The threaded rod can be tensioned to just take the load of the boiler off of the sub-structure allowing repairs to be made in safety. These cables and straps include a safety factor of four (4) and will be tested with dial indicators for working loads; anticipate three straps per boiler. Section 106 remediation to put this back to original would require removal of the support gear and welding the circular holes in the armor deck back to original.

Remediation of asbestos as needed in Drying and Boiler Rooms #3 & #4.	170,000.00
Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR	74,000.00
Remediation of standing oil in Boiler Rooms, piping and tanks	75,000.00
Map & remove vertical stanchions and deck grating and piping/components over deck	75,000.00
Drill twenty-four (24) 2" holes in armor deck, suspend four (4) boilers	158,000.00
Twenty-four (24) 1 1/4" x 6 x 19" bright wire, uncoated, fiber core (FC) wire (IPC) with eyes	52,800.00
Twelve 2 ply 24" x 30' nylon straps	34,560.00
Twenty-four 1 1/2" classed shackles	2,251.20
Twenty-four 1 1/4" x 2' threaded rod with eyes	5,496.00
Twenty-four 1 1/4" nuts	310.80
Sixteen (16) 10 x 60 x 30' steel I-beams	28,480.00
1" x 24" x 240' plate steel	16,320.00
Crop out and replace 1,600 sq. ft of 1/2" A-36 steel deck plate as needed.	600,000.00
Re-install vertical stanchions and deck grating and piping/components over deck	75,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)	12,500.00

<b>Task #4</b>	<b>\$ 1,379,718.00</b>
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**TASKING****ESTIMATED  
COST****Task 5.3 B-3-4-W, Port, Reserve Feed Water Tank****Tasking for B-3-4-W**

Tank repair methodology in B-3 requires that both boilers be supported as previously discussed in #4. The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boiler will allow steel plate to be inserted into the Hold tankage space to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

## Tasking for B-3-4-W

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR	\$	65,000.00
Crop/replace longitudinal plating (1/2" x 16'L x 4' H) on #1 longitudinal 64 sq. ft x 1/2"		22,400.00
Crop/replace longitudinal plating (1/2" x 16'L x 4' H) on #2 longitudinal 64 sq. ft x 1/2"		22,400.00
Crop/replace transverse plating (3/8" x 24'L x 4'H) on # 1 transverse 96 sq. ft x 3/8"		28,800.00
Crop/ replace transverse plating (3/8" x 24'L x 4'H) on # 2 transverse 96 sq. ft x 3/8"		28,800.00
Crop/ replace transverse plating (3/8" x 24'L x 4'H) on # 3 transverse 96 sq. ft x 3/8"		28,800.00
Replace four 1/2" plating knees for boiler foundations. 40 sq. ft x 3/8"		12,000.00
Replace two 1/2" x 4" x 10" x 24' channel beams for boiler foundations.		7,200.00
Prime all new work with two coats INTERNATIONAL 300V epoxy primer.		7,000.00
<b>Task 5.3</b>	<b>\$</b>	<b>222,400.00</b>



**TASKING****ESTIMATED  
COST****5.4 B-3-3-W, Starboard, Reserve Feed Water Tank****Tasking for B-3-3-W**

Tank repair methodology in B-3 requires that both boilers be supported as previously discussed in #4. The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boiler will allow steel plate to be inserted into the Hold tankage space to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

## Tasking for B-3-3-W

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 65,000.00
Crop/replace longitudinal plating (1/2" x 16L' x 4' H) on #1 longitudinal	64 sq. ft x 1/2"	22,400.00
Crop/replace longitudinal plating (1/2" x 16'L x 4' H) on #2 longitudinal	64 sq. ft x 1/2"	22,400.00
Crop/replace transverse plating (3/8" x 24'L x 4'H) on # 1 transverse	96 sq. ft x 3/8"	28,800.00
Crop/ replace transverse plating (3/8" x 24'L x 4'H) on # 2 transverse	96 sq. ft x 3/8"	28,800.00
Crop/ replace transverse plating (3/8" x 24'L x 4'H) on # 3 transverse	96 sq. ft x 3/8"	28,800.00
Replace four 1/2" plating knees for boiler foundations.	40 sq. ft x 3/8"	12,000.00
Replace two 1/2" x 4" x 10" x 24' channel beams for boiler foundations.		7,200.00
Prime all new work with two coats INTERNATIONAL 300V epoxy primer.		7,000.00
<b>Task 5.4</b>		<b>\$ 222,400.00</b>

**TASKING****ESTIMATED  
COST****8.1 B-4-2-W, PORT RESERVE FEED WATER TANK****Tasking for B-4-2-W**

Tank repair methodology in B-4 requires that both boilers be supported as previously discussed in #4, The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boiler will allow steel plate to be inserted into the Hold tankage space to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

**Tasking for B-4-2-W**

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR	\$	65,000.00
Crop/replace longitudinal plating (1/2" x 16'L x 4' H) on #1 longitudinal 64 sq. ft x 1/2"		22,400.00
Crop/replace longitudinal plating (1/2" x 16'L x 4' H) on #2 longitudinal 64 sq. ft x 1/2"		22,400.00
Crop/replace transverse plating (3/8" x 24'L x 4'H) on # 1 transverse 96 sq. ft x 3/8"		28,800.00
Crop/ replace transverse plating (3/8" x 24'L x 4'H) on # 2 transverse 96 sq. ft x 3/8"		28,800.00
Crop/ replace transverse plating (3/8" x 24'L x 4'H) on # 3 transverse 96 sq. ft x 3/8"		28,800.00
Crop/replace transverse plating (3/8" x 24'L x 4'H) on # 4 transverse 96 sq. ft x 3/8"		28,800.00
Replace four 1/2" plating knees for boiler foundations. 40 sq. ft x 3/8"		12,000.00
Replace two 1/2" x 4" x 10" x 24' channel beams for boiler foundations.		7,200.00
Prime all new work with two coats INTERNATIONAL 300V epoxy primer.		7,000.00
<b>Task 8.1</b>	<b>\$</b>	<b>251,200.00</b>

**TASKING****ESTIMATED  
COST****8.2 B-4-1-W, STARBOARD RESERVE FEED WATER TANK****Tasking for B-4-1-W**

Tank repair methodology in B-4 requires that both boilers be supported as previously discussed in #4, The boiler room deck is perforated in many areas and needs to be replaced where it is holed. This will involve the mapping and removal of the steel grating and associated piping beneath to allow access to the deck. The removal of the deck, particularly beneath the boiler will allow steel plate to be inserted into the Hold tankage space to repair both longitudinal and transverse frame plating. Other areas remote from where the overhead deck is to be repaired will require cutting/burning into those tanks below to affect repairs beneath the boilers; these cuts can be reversed by re-installing the cut-out deck plating.

**Tasking for B-4-4-W**

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 65,000.00
Crop/replace longitudinal plating (1/2" x 16L' x 4' H) on #1 longitudinal	64 sq. ft x 1/2"	22,400.00
Crop/replace longitudinal plating (1/2" x 16'L x 4' H) on #2 longitudinal	64 sq. ft x 1/2"	22,400.00
Crop/replace transverse plating (3/8" x 24'L x 4'H) on # 1 transverse	96 sq. ft x 3/8"	28,800.00
Crop/ replace transverse plating (3/8" x 24'L x 4'H) on # 2 transverse	96 sq. ft x 3/8"	28,800.00
Crop/ replace transverse plating (3/8" x 24'L x 4'H) on # 3 transverse	96 sq. ft x 3/8"	28,800.00
Crop/replace transverse plating (3/8" x 24'L x 4'H) on # 4 transverse	96 sq. ft x 3/8"	28,800.00
Replace four 1/2" plating knees for boiler foundations.	40 sq. ft x 3/8"	12,000.00
Replace two 1/2" x 4" x 10" x 24' channel beams for boiler foundations.		7,200.00
Prime all new work with two coats INTERNATIONAL 300V epoxy primer.		7,000.00
<b>Task 8.2</b>		<b>\$ 251,200.00</b>

**TASKING****ESTIMATED  
COST****12.1 ENGINE SUPPORTS (C-1, STARBOARD & C-2, PORT)****Tasking for C-1 & C-2**

For the purposes of cost estimating, the size of the hardware used to suspend the engines is approximated. The final method of removing the load of the engines from the structure beneath will require design by a licensed engineer.

Perform asbestos remediation on friable asbestos before any work is contemplated.	\$ 80,000.00
Map & remove any obstructions, wiring, piping in way of lay-down area of supporting I-beams on protective deck. Re-install upon completion of work.	200,000.00
Have both enginerooms and Inner Bottom Tanks cleaned and free of oil (especially C-1, C-2, C-95, C-97, & C-99F) for hot work. Contiguous tankage that requires cleaning of any/all oil residue are as follows for hot work: C-92F, C-93F, C-84F, C-86F, C-88F, D-92F, D-97F, C-85F, C-87F, C-89F, D-91F	425,000.00
Map prior to removal and remove any vertical stanchions, deck gratings, fuel piping and appurtenances in way of Inner Bottom Tankage.	150,000.00
Install twenty (five per side of engine) 1" x 12" x various length steel plate brackets to support lateral support of main engine; attach to engine foundations	25,000.00
Drill eighty-eight (88) 3" holes in armor deck, assemble I-beams, rod & suspension wires, suspend two (2) main engines	450,000.00
Materials	
Eight 14 x 16 x 66' I-beams	42,700.00
Four 2" x 32" W x 66' A-36 Flat Steel Plate	28,176.00
Forty-four (44) 2" x 60' wire with eyes and fendering	132,000.00
Forty-four (44) 2" classed proofed shackles, 2" classed nuts, fender washers	6,200.00
Forty four (44) 2" x 3' long threaded rod with eyes	14,500.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)	2,500.00
Return space(s) to original upon completion of repairs.	

<b>Task 12.1</b>	<b>\$ 1,556,076.00</b>
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**TASKING****ESTIMATED  
COST**

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**12.2 ENGINE ROOM DECK (C-1, STARBOARD & C-2, PORT)****Tasking for C-1 & C-2**

Completely photo document and record textual information about all piping, electrical and structural members in way spaces above engine room floors for Section 106 requirements and present documentation to Project Manager.

Verify that piping is not filled with oil, remediate as needed. Remediate red lead where steel is to be cut 4" to either side of cut/welded seam per 29 CFR.

Remove all piping, deck gratings, stanchions for deck gratings, minor equipment to allow access to floor plating.

Remove old floors as needed. Fabricate and install 3,600 square feet of new ½" ASTM A-36 steel plate into exposed areas over Inner Bottom tankage. Prime floor with two coats of International 300V primer.

Upon completion of repairs, return all spaces to original configuration.

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<b>Task 12.2</b>	<b>\$ 2,745,000.00</b>
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**TASKING****ESTIMATED  
COST****14.2 EMERGENCY FUEL TANK, C-94F PORT****Tasking for C-94F**

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 65,000.00
Cut into Engineroom deck for access as needed for tank.		30,000.00
Crop/replace portion of forward bulkhead at Frame # 89 from keel to tank boundary (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 1/2"	63,000.00
Crop/replace portion of aft bulkhead at Frame # 94 from keel to tank boundary (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 1/2"	63,000.00
Crop/replace Longitudinals # 1 – 4 to tank boundary (1/2" x 4 1/2' x 80' A-36 steel plate)	360 sq. ft. x 1/2"	126,000.00
Crop/replace main Transverses (4) from keel to tank boundary (3/8" x 4 1/2' x 160' A-36 steel plate)	720 sq. ft x 3/8"	216,000.00
Crop/replace intermediate Transverses (4) from keel to #4 Longitudinal (3/8" x 4 1/2' x 128' A-36 steel plate)	576 sq. ft. x 3/8"	172,800.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		12,000.00
Return space(s) to original upon completion of repairs.		280,000.00
<b>Task 14.2</b>		<b>\$ 1,027,800.00</b>

**TASKING****ESTIMATED  
COST**

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**14.3 EMERGENCY FUEL TANK, C-95F STARBOARD****Tasking for C-95F**

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 65,000.00
Cut into Engineroom deck for access as needed for tank.		30,000.00
Crop/replace portion of forward bulkhead at Frame # 89 from keel to tank boundary (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 1/2"	63,000.00
Crop/replace portion of aft bulkhead at Frame # 94 from keel to tank boundary (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 1/2"	63,000.00
Crop/replace Longitudinals # 1 – 4 to tank boundary (1/2" x 4 1/2' x 80' A-36 steel plate)	360 sq. ft. x 1/2"	126,000.00
Crop/replace main Transverses (4) from keel to tank boundary (3/8" x 4 1/2' x 160' A-36 steel plate)	720 sq. ft x 3/8"	216,000.00
Crop/replace intermediate Transverses (4) from keel to #4 Longitudinal (3/8" x 4 1/2' x 128' A-36 steel plate)	576 sq. ft. x 3/8"	172,800.00
Re-install disturbed overhead deck plating to original.		280,000.00
Prime all new surfaces with two coats International 300V primer.		12,000.00
	<b>Task 14.3</b>	<b>\$ 1,027,800.00</b>

**TASKING****ESTIMATED  
COST**

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**14.4 EMERGENCY FUEL TANK, C-96F PORT****Tasking for C-96F**

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 65,000.00
Cut into Engineroom deck for access as needed for tank.		30,000.00
Crop/replace portion of aft bulkhead at Frame # 99 from keel to tank boundary (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 1/2"	63,000.00
Crop and replace Longitudinals # 1 – 4 to tank boundary. 1/2" x 4 1/2' x 80' A-36 steel plate.	360 sq. ft x 1/2"	126,000.00
Crop/replace main Transverses (4) from keel to tank boundary (3/8" x 4 1/2' x 160' A-36 steel plate)	720 sq. ft x 3/8"	216,000.00
Crop & replace intermediate Transverses (5) from keel to #4 Longitudinal (3/8" x 4 1/2' x 200' A-36 steel plate)	900 sq. ft x 3/8"	270,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		12,000.00
Return space(s) to original upon completion of repairs.		280,000.00
<b>Task 14.4</b>		<b>\$ 1,062,000.00</b>



**TASKING****ESTIMATED  
COST****14.5 EMERGENCY FUEL TANK, C-97F STARBOARD****Tasking for C-97F**

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 65,000.00
Cut into Engineroom deck for access as needed for tank.		30,000.00
Crop/replace portion of aft bulkhead at Frame # 99 from keel to tank boundary (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 1/2"	63,000.00
Crop and replace Longitudinals # 1 – 4 to tank boundary. 1/2" x 4 1/2' x 80' A-36 steel plate.	360 sq. ft x 1/2"	126,000.00
Crop/replace main Transverses (4) from keel to tank boundary (3/8" x 4 1/2' x 160' A-36 steel plate)	720 sq. ft x 3/8"	216,000.00
Crop & replace intermediate Transverses (5) from keel to #4 Longitudinal (3/8" x 4 1/2' x 200' A-36 steel plate)	900 sq. ft x 3/8"	270,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		12,000.00
Return space(s) to original upon completion of repairs.		280,000.00
<b>Task 14.5</b>	<b>\$</b>	<b>1,062,000.00</b>

TASKING	ESTIMATED COST
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## 14.6 EMERGENCY FUEL TANK, C-98F PORT

### Tasking for C-98F

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 65,000.00
Cut into Engineroom deck for access as needed for tank.		30,000.00
Crop/replace portion of aft bulkhead at Frame # 104 from keel to tank boundary (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 1/2"	63,000.00
Crop and replace Longitudinals # 1 – 4 to tank boundary. (1/2" x 4 1/2' x 80' A-36 steel plate) 126,000.00	360 sq. ft x 1/2"	126,000.00
Crop/replace main Transverses (4) from keel to tank boundary (3/8" x 4 1/2' x 160' A-36 steel plate)	720 sq. ft x 3/8"	216,000.00
Crop/replace intermediate Transverses (2) from keel to #4 Longitudinal (3/8" x 4 1/2' x 80' A-36 steel plate)	360 sq. ft. x 3/8"	108,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		12,000.00
Return space(s) to original upon completion of repairs.		280,000.00
<b>Task 14.6</b>	<b>\$</b>	<b>900,000.00</b>

**TASKING****ESTIMATED  
COST**

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**14.7 EMERGENCY FUEL TANK, C-99F STARBOARD****Tasking for C-99F**

Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 65,000.00
Cut into Engineroom deck for access as needed for tank.		30,000.00
Crop/replace portion of aft bulkhead at Frame # 104 from keel to tank boundary (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 1/2"	63,000.00
Crop and replace Longitudinals # 1 – 4 to tank boundary. (1/2" x 4 1/2' x 80' A-36 steel plate)	360 sq. ft x 1/2"	126,000.00
Crop/replace main Transverses (4) from keel to tank boundary (3/8" x 4 1/2' x 160' A-36 steel plate)	720 sq. ft x 3/8"	216,000.00
Crop/replace intermediate Transverses (2) from keel to #4 Longitudinal (3/8" x 4 1/2' x 80' A-36 steel plate)	360 sq. ft. x 3/8"	108,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		12,000.00
Return space(s) to original upon completion of repairs.		280,000.00
	<b>Task 14.7</b>	<b>\$ 900,000.00</b>

TASKING	ESTIMATED COST	
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14.8 KEEL, FRAMES 89 - 104		
Task for Keel		
Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		\$ 35,000.00
Cut into Engineroom deck for access as needed for tank.		15,000.00
Crop/replace vertical flat plating of keel with new ¾" x 4 ½' x 64' long A-36 steel plate between Frames 89 – 104.	288 sq. ft x ¾"	125,000.00
Crop/ replace diagonal support brackets (52) for keel with new ¾" A-36 steel plate; weld to new vertical keel plate and base of old flange between every transverse frame.	416 sq. ft x ¾"	166,400.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		12,000.00
Return space(s) to original upon completion of repairs.		150,000.00
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Task 14.8	\$	503,400.00

**TASKING****ESTIMATED  
COST****17. AFTER EMERGENCY DIESEL GENERATOR ROOM, D-11, Frames 115 – 120****Tasking for D-11**

For the purposes of cost estimating, the size of the hardware used to suspend the diesel generator is approximated. The final method of removing the load of the diesel generator from the structure beneath will require design by a licensed engineer.

Perform asbestos & PCB remediation on this space before any work is contemplated.		\$ 45,000.00
Perform oil remediation on D-11 & D-98F and make safe for 'hotwork'.		28,000.00
Remove gear in way of diesel generator, forward & aft bulkhead and re-install upon completion of repairs		15,000.00
Perform remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		20,000.00
Crop/replace portion of forward bulkhead at Frame # 115 from top of keel to overhead (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 3/8	54,000.00
Crop/replace portion of aft bulkhead at Frame # 104 from keel to overhead (1/2" x 4 1/2' x 40' A-36 steel plate)	180 sq. ft. x 3/8"	54,000.00
Crop/replace wasted door frame & install new 30" x 60" dogging door at Frame # 120, aft bulkhead.		6,200.00
Generator weighs a maximum of 25 tons and a safety factor of four is recommended to support diesel generator. Install four bolted padeyes from pair of transverse frames over diesel generator.. Suspend diesel generator from overhead with two 1" 6 x 19 51.7 ton x 25' nominal breaking strength classed bright wire shackled into existing 3/8" x 3" x 10" transverse frames pad eyes.		
Labor to suspend generator		15,000.00
Materials		
Two 1" 6 x 19 IPS 51.7 ton x 25' bright wires with eyes in each end		6,900.00
Four 60 ton classed shackles		415.00
Four 2" x 6" x 6" steel pad eyes welded to overhead frames		1,800.00
Crop/replace 500 sq. ft. of 3/8" steel deck within compartment after suspending Generator and repair of Inner Bottom Tank below	500 sq. ft x 3/8"	150,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		12,000.00
Return space(s) to original upon completion of repairs.		30,000.00
<b>Task 17</b>		<b>\$ 438,315.00</b>



**TASKING****ESTIMATED  
COST****19. VOID SPACE, D-99, Frames 115 – 122****Tasking for D-99V**

This space is directly under the Aft Emergency Diesel Room and is in poor structural condition. All transverse and longitudinal frames shall be replaced, the fore and aft bulkheads shall be replaced and the keel shall be repaired.

After removal of overhead deck plating complete the following:

Clean/certification of spaces D-98F, D-95V and D-96V are safe for 'hotwork'.		\$ 35,000.00
Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		65,000.00
Crop/replace longitudinal plating (1/2" x 28L' x 4' H) on #1 longitudinal	112 sq. ft x 1/2"	39,200.00
Crop/replace longitudinal plating (1/2" x 18'L x 4' H) on #2 longitudinal	112 sq. ft x 1/2"	39,200.00
Crop/replace longitudinal plating (1/2" x 18'L x 4' H) on #3 longitudinal	112 sq. ft x 1/2"	39,200.00
Crop and replace transverse plating (3/8" x 30'L x 4'H) on # 1 transverse	120 sq. ft x 3/8"	36,000.00
Crop and replace transverse plating (3/8" x 30'L x 4'H) on # 2 transverse	120 sq. ft x 3/8"	36,000.00
Crop and replace transverse plating (3/8" x 30'L x 4'H) on # 3 transverse	120 sq. ft x 3/8"	36,000.00
Crop and replace transverse plating (3/8" x 30'L x 4'H) on # 4 transverse	120 sq. ft x 3/8"	36,000.00
Crop and replace transverse plating (3/8" x 28'L x 4'H) on # 5 transverse	112 sq. ft x 3/8"	33,600.00
Crop and replace transverse plating (3/8" x 28'L x 4'H) on # 6 transverse	112 sq. ft x 3/8"	33,600.00
Crop and replace vertical flat plating of keel with new 3/4" x 4 1/2' x 28' long A-36 steel plate between Frames 115 – 122		50,400.00
Crop and replace diagonal support brackets (14) for keel with new 3/4" A-36 steel plate; weld to new vertical keel plate and base of old flange between every transverse frame.	60 sq. ft. x 3/4"	24,000.00
Crop out and replace both forward and aft bulkhead of tank with approx. 300 sq. ft of 3/8" A-36 steel plate.	300 sq. ft of 3/8"	90,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		16,000.00
Return space(s) to original upon completion of repairs.		30,000.00

<b>Task 19</b>	<b>\$ 629,200.00</b>
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**TASKING****ESTIMATED  
COST****22. 2<sup>ND</sup> PLATFORM & HOLD , TRIMMING TANK (D-12) & STOREROOMS  
OUTBOARD OF STEERING ROOM (D-25), Frames 122 – 129 (cont.)****Tasking D-12**

The schedule of repairs in D-12 shall proceed as follows:

Install adequate lighting for entire compartment.		\$ 500.00
Install new ladders for forward and aft scuttles to safely access D-12 Trimming Tank.		1,200.00
Install framework for installing wood plank floor for footing and remove as repairs proceed from forward to aft		2,200.00
Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR for D-26P, D-26S & D-12		45,000.00
Crop and install new 3/8" steel bulkhead at Frame 122.	125 sq. ft. x 3/8"	36,600.00
Install new 3/8" steel bulkhead at Frame 129.	220 sq. ft. x 3/8"	66,000.00
Crop and replace vertical flat plating of keel with new 3/4" x 4 1/2' x 28' long A-36 steel plate between Frames 122 - 129.	200 sq. ft x 3/4"	80,000.00
Replace five (5) centerline 6" O.D. 1/2" wall vertical stanchions (3 of 12', 1 of 11', 1 of 10') and tie into keelson plate and overhead frames.	60' 1/2" wall tube	12,945.00
Crop/replace longitudinal plating (1/2" x 28'L x 4' H) on #1 longitudinal.	112 sq. ft. x 1/2"	39,200.00
Crop/replace longitudinal plating (1/2" x 28'L x 4' H) on #2 longitudinal.	112 sq. ft x 1/2"	39,200.00
Crop/replace longitudinal plating (1/2" x 28L' x 2' H) on #3 longitudinal,	70 sq. ft. x 1/2"	24,500.00
Crop/replace longitudinal plating (1/2" x 28L' x 2' H) on #4 longitudinal,	70 sq. ft. x 1/2"	24,500.00
Crop/replace transverse plating (3/8" x 44'L x 2'H) on Frame 123 transverse	90 sq. ft x 3/8"	31,500.00
Crop and replace transverse plating (3/8" x 44'L x 2'H) on Frame 124 transverse	90 sq. ft x 3/8"	31,500.00
Crop/replace transverse plating (3/8" x 40'L x 2'H) on Frame 125 transverse	80 sq. ft x 3/8"	28,000.00

**TASKING****ESTIMATED  
COST**

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**22. 2<sup>ND</sup> PLATFORM & HOLD , TRIMMING TANK (D-12) & STOREROOMS  
OUTBOARD OF STEERING ROOM (D-25), Frames 122 – 129 (cont.)****Tasking D-12 (cont.)**

Crop/replace transverse plating (3/8" x 40'L x 2'H) on Frame 126 transverse	80 sq. ft x 3/8"	\$ 28,000.00
Crop/replace transverse plating (3/8" x 38'L x 2'H) on Frame 127 transverse	60 sq. ft x 3/8"	26,600.00
Crop/replace transverse plating (3/8" x 38'L x 2'H) on Frame 128 transverse	60 sq. ft x 3/8"	26,600.00
Remove shelving, components from D-26P & D-26S		20,000.00
Crop/replace floors in D-26P & D-26S	336 sq. ft. x 3/8"	117,600.00
Install interior cofferdam plating between Transverse Frames 122 and 129 from overhead to keel to contain shell plate leaks. 1,680 sq. ft x 1/4"		420,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		18,925.00
Return space(s) to original upon completion of repairs.		30,000.00
<b>Task 22</b>		<b>\$ 1,150,570.00</b>

**TASKING****ESTIMATED  
COST****24. 2<sup>ND</sup> PLATFORM & HOLD, TRIMMING TANK D-13, STEERING GEAR ROOM  
D-27, frames 129 – 137 (cont.)****Tasking D-27**

For the purposes of cost estimating, the size of the hardware used to suspend the steering gear is approximated. The final method of removing the load of the steering gear from the structure beneath will require design by a licensed engineer.

The schedule of repairs for D-27 is as follows:

Install adequate lighting for entire compartment.	\$	500.00
Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR.		30,000.00
Crop and replace bottom 5' of plating on Transverse Frames 130 - 133 throughout D-27 with new 3/8" A-36 plating and match frame profiles	160 sq. ft x 3/8" plate	48,000.00
Suspend steering rams (100 tons) from overhead 3/8" x 4" x 10" channel transverse frames with four 1 1/2" 6 x 19 classed bright improved plow steel IRWC wire with a nominal strength of 114 tons with a safety factor of four (4).		
Labor to suspend steering rams and components		28,000.00
<b>Materials</b>		
Four (4) 15' 1 1/2" 6 x 19 classed bright improved plow steel IRWC wire with eyes		11,400.00
Eight (8) classed 1 1/2" shackles		825.00
Eight 1" x 6" x 6" steel pads with 3" eyes to mount to overhead frames		3,600.00
Crop and replace bottom plating on Transverse Frames 134 - 136 and base half frames under rudder crosshead with new 1/2" A-36 plating and match frame profiles	200 sq. ft. x 1/2" plate	70,000.00
Replace aft Bulkhead at Frame 137.	80 sq. ft. x 1/2" plate	31,500.00
Install 3' x 5' x 1/2" doubler plate under steering component forward	15 sq. ft x 1/2" plate	7,000.00
Upon suspension of steering gear, crop and replace deck throughout compartment with new 1/2" A-36 steel plate	672 sq. ft. of 1/2" plate	235,200.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		15,000.00
Return space(s) to original upon completion of repairs.		10,000.00

<b>Task 24</b>	<b>\$</b>	<b>491,025.00</b>
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**TASKING****ESTIMATED  
COST****26. 2<sup>nd</sup> PLATFORM VOID D-107, FRAMES 137 – AFT PERPENDICULAR (cont.)****Tasking D-107**

The schedule of repairs for D-107 is as follows:

Install adequate lighting for entire compartment.		\$	500.00
Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR.			30,000.00
Crop and replace plating on Transverse Frames 136 – 140 through-out D-27 with new 3/8" A-36 plating and match frame profiles	200 sq. ft x 3/8" plate		70,000.00
Crop out and replace three transverse bulkhead frames in base of compartment with new 3/8" A-36 plating and match frame profiles	140 sq. ft. x 3/8" plate		49,000.00
Install interior cofferdam plating between Transverse Frames 137 and 141 from overhead to keel to contain shell plate leaks.	800 sq. ft x 1/4" plate		200,000.00
Install 1/4" A-36 doubler plate over holed plating on transom above waterline.	300 sq. ft x 1/4" plate		75,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)			15,000.00
Return space(s) to original upon completion of repairs.			10,000.00
<b>Task 26</b>		<b>\$</b>	<b>449,500.00</b>



<b>TASKING</b>	<b>ESTIMATED COST</b>
<b>28. VOIDS D-101, D-102, D-103, FRAMES 123 – 137 (cont.)</b>	
<b>Tasking D-101, D-102 &amp; D-103</b>	
Install adequate lighting for entire compartment.	\$ 750.00
Remediate all friable asbestos as required under 29 CFR	15,000.00
Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR	30,000.00
Crop and replace forty-eight (48) vertical stanchions through-out D-101, D-102 & D-103. 48 x 3/8" x 6" x 6" x 320' I-beams	67,500.00
Crop out and replace ninety-six (96) stanchion bases 1" steel pads throughout D-101, D-102 & D-103. 96 x 1" x 8" x 8" steel base plates	24,400.00
Crop out and replace wasted bulkheads at Frame # 134 & # 137 600 sq. ft x 3/8" steel plate	180,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)	15,000.00
Return space(s) to original upon completion of repairs.	10,000.00
<b>Task 28</b>	<b>\$ 342,650.00</b>

TASKING	ESTIMATED COST
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### 30. THIRD DECK, CPO QUARTERS D-111, CPO MESS ROOM D-112, CPO PANTRY D-113

#### 30.1 Tasking D-111

Install adequate lighting for entire compartment.	\$	750.00
Remediate all friable asbestos as required under 29 CFR		15,000.00
Remediation of red lead where steel is to be cut 4" to either side of cut per 29 CFR		30,000.00
Replace five (5) centerline 6" O.D. ½" wall vertical stanchions	60' ½" wall tube	12,945.00
Crop out and replace ten (10) stanchion bases 1" steel pads in D-111	(10) 1" x 8" x 8" steel pads	3,000.00
Crop out and replace wasted bottom 3' bulkheads at Frame # 134 & # 137.	370 sq. ft. of 3/8" A-36 plate	111,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		8,000.00
<b>Task 30.1</b>		<b>\$ 180,695.00</b>

#### 30.2 Tasking D-112

Install adequate lighting for entire compartment.	\$	750.00
Remediate all friable asbestos as required under 29 CFR		15,000.00
Crop/ replace three (3) 6" O.D. x ½" wall vertical stanchions in D-112	(3) 6" O.D. x ½" wall x 86" stanchions	7,767.00
Crop/replace six (6) stanchion bases 1" steel pads in D-111	(12) 1" x 8" x 8" steel pads	3,600.00
Crop/replace wasted bottom 3' bulkheads at Frame # 137.	150 sq. ft. of 3/8" A-36 plate	45,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)		8,000.00
<b>Task 30.2</b>		<b>\$ 80,117.00</b>

TASKING	ESTIMATED COST
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<b>30. THIRD DECK, CPO QUARTERS D-111, CPO MESS ROOM D-112, CPO PANTRY D-113 (cont.)</b>	
<b>30.3 Tasking D-113</b>	
Install adequate lighting for entire compartment.	\$ 750.00
Remediate all friable asbestos as required under 29 CFR	10,000.00
Crop/ replace three (3) 6" O.D. x 1/2" wall vertical stanchions in D-112	
(2) 6" O.D. x 1/2" wall stanchions	5,178.00
Crop/replace six (6) stanchion bases 1" steel pads in D-111	
(4) 1" x 8" x 8" steel pads	1,200.00
Crop/replace wasted deck in C-113.	
50 sq. ft. of 1/2" A-36 plate	20,000.00
Prime all new work with two coats INTERNATIONAL 300V epoxy prime (Labor & materials)	3,000.00
<b>Task 30.3</b>	<b>\$ 40,128 .00</b>